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The Practical Manual *of* Dental Casting

BEING THE RECORDED EXPERIENCES
OF MANY ABLE AND EMINENT MEN
IN THE DENTAL PROFESSION

PROFUSELY ILLUSTRATED

Reprinted from THE DENTAL SUMMARY 1909-1919

THIRD EDITION
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PREPARATION OF CAVITIES FOR GOLD INLAYS

BY W. H. O. MCGEHEE, M.D., D.D.S., CLEVELAND, OHIO

Francis Bacon has said that "the greatest trust between man and man is the trust of giving counsel." Ralph Waldo Emerson is responsible for the following immortal words: "He teaches who gives, and he learns who receives. There is no teaching until the pupil is brought into the same state or principle in which you are; a transfusion takes place—he is you, and you are he; then there is a teaching, and by no unfriendly chance or bad company can he ever lose the benefit."

I come as much to be taught as to teach; and I would request, that this transfusion of thought and personality of which Emerson speaks be accomplished at once, and that we for the next hour commune together. Let my readers become the teacher, and I shall become the pupil. Then indeed will we both be repaid fully for the efforts expended and the thoughts elicited.

There is no phase of dentistry which is of greater importance to the general practitioner than that of cavity preparation. Inasmuch as the daily work of the average dentist is largely concerned in the adaptation into prepared cavities of filling materials for the restoration of lost tooth structure, it might almost be considered the keynote to successful dental practice of today. If the cavity be improperly prepared, if the foundation be formed along incorrect lines, the superstructure—the filling material—will be placed on insecure ground and will succumb easily to the stresses later to be brought to bear upon it.

The great majority of men conducting a modern dental practice are supposed to have some theortical knowledge of the laws governing correct cavity preparation; and yet anyone who is observant of conditions will readily agree with the statement that there are really comparatively few who are daily carrying out in detail these laws. This is in a way an astounding statement, and a sad commentary on the frailties of human nature. Nevertheless, my experience has been that it is true.

I have been engaged in the rather prosaic occupation of teaching dentistry for a period of about nineteen years. During that time it has fallen to my lot to see many cavity preparation operations performed by students, as well as a large number of defective fillings which have been placed in cavities prepared by dentists. During that period I have observed that the tendency of the average dental student is to slight his cavity preparation if he is given the opportunity; and I have grown to believe that the average dentist will do the same thing in many instances. Has the profession the moral right to do this? An imperfectly-prepared cavity is soon hidden by the filling material placed in it, it is true, and I believe that this is the obviously poor argument uppermost in the mind of the man who performs the defective operation. I believe that this is one of the most frequent causes of failure of filling operations as well as of unsuccessful careers as dental practitioners.

Cavity preparation was a number of years ago placed on a definite scientific basis by the lamented G. V. Black and his co-laborers, and I sometimes feel like offering an apology when I am invited to discuss the subject. Remembering the above facts, however, I have gradually arrived at the conclusion that it is only the frequent discussions and repeated demonstrations that the importance of correct cavity forms can be impressed upon the profession in general. The failure of many of the profession to appreciate the importance of the subject, can to my mind, be attributed to one of two factors; that is to say, either ignorance of the laws of cavity preparation or carelessness in regard to the evils resulting. For the first condition there can be no excuse, since these laws may be learned readily by consulting any modern textbook on operative dentistry. "Ignorance is the curse of God; knowledge the wings wherewith we fly to heaven." There is no profession in which minutae of detail is of greater importance than in the profession of dentistry. This being the case, then, I take it that the sin of carelessness is one of the greatest shortcomings of which the dentist possibly could be guilty. A recent writer is responsible for the following remarkable effusion:

"I am more powerful than the combined armies of the world.

"I have destroyed more men than all the wars of the nations.

"I am more deadly than bullets, and I have wrecked more homes than the mightiest of siege guns.

"I steal in the United States alone over $500,000,000 each year.

"I spare no one and I find my victims among the rich and the poor alike, the young and the old, the strong and weak. Widows and orphans know me.

"I loom up to such proportions that I cast my shadow over every field of labor, from the turning of the grindstone to the moving of every railroad train.

"I massacre thousands of wage earners in a year.

"I lurk in unseen places, and do most of my work silently. You are warned against me but you heed not.

"I am relentless.

"I am everywhere—in the house, on the streets, in the factory, at railroad crossings, and on the sea.

"I bring sickness, degradation and death; yet few seek to avoid me.

"I destroy, crush, or maim; I give nothing, nothing—but take all.

"I am your worst enemy.

"I am *Carelessness*."

It seems to me that it behooves us to become more deeply imbued with the idea of service—service to our patients, service to our profession, service to humanity, if we would avoid the consequences of this major sin and desire to bring out our highest capabilities as professional men. Then, and then only, will careless operating and slipshod cavity preparations be things of the past.

Cavity preparation for the gold inlay differs very little from that for a gold filling, except in the method of retention and the time for providing for it. It is exceedingly important, if the best results are to be obtained, that adequate access be provided for by producing sufficient separation of the teeth. This is a point which frequently is neglected, resulting in increased difficulty in withdrawal of the wax pattern and marring of the contact point, as well as obscuring the view of the cavity and interference with proper instrumentation. If sufficient separation be obtained, it will not be necessary to contour the wax model tightly against the proximating tooth in proximal cavities.

There has been quite a discussion for a number of years as to the advantages and disadvantages of the gold inlay, the advocates of the gold filling claiming closer adaptation to cavity walls and a gripping of the filling in place by the normal resilience or elasticity of vital dentin, as well as the absence of the cement line; whereas the champions of the gold inlay cite the great time-saving and energy-preserving properties incident to the construction of the inlay. The great majority of failures with the gold inlay undoubtedly have been due to lack of appreciation of the importance of correct cavity preparation, and to their use under improper conditions and in wrong localities. If the cavity be properly prepared, the inlay will be either locked into place by the dovetail form of the cavity itself, or be held in position by pins placed in proper localities. Too much reliance frequently is placed on the adhesive properties of the cement to retain the inlay in position. *The cement should be used only as a sealing agent for the joint between the inlay and the cavity wall.* In addition to this, if the cavity margin be strongly beveled, as it should, and the margins of the perfect inlay efficiently burnished, the underlying cement will not only be entirely covered, but will be protected from the entrance of saliva by the overlying gold.

The prime objects to be kept in mind, then, during the construction of the inlay are *first,* proper cavity preparation; *second,* restoration of lost contour and occlusion, and *third,* complete covering of the cement at the margins through adequate burnishing of the thin edge of the inlay over the obtuse marginal bevel.

The indications for the gold inlay may be mentioned as follows:

First: For restoration of abraded incisal and occlusal surfaces.

Second: For large contour restorations in badly broken-down posterior teeth, as a substitute for the shell crown.

Third: As a time saver when it becomes necessary to construct a number of fillings in a limited time.

Fourth: In cavities in which the continued exclusion of moisture for lengthy operations is impossible.

Fifth: In invalid, convalescent or young patients, unable to bear prolonged gold-building operations.

Sixth: In teeth with weakened peridental membranes.

Gold inlays are not indicated in small cavities, or shallow cavities whose outline is not extensive. They are also, in the majority of cases, contraindicated in proximal cavities not involving the angle, unless these are large and the lingual wall has been lost, thus allowing ready withdrawal of the wax model and insertion of the inlay from the lingual aspect.

The steps in cavity preparation may be reviewed as follows:

First: Establish the outline form.

Second: Remove the decay.

Third: Give the cavity form. (*a*) Convenience form; (*b*) Resistance form; (*c*) Retention form.

Fourth: Bevel and polish the enamel margins.

Fifth: Perform the toilet of the cavity.

Although there is frequently an overlapping of these steps, and sometimes a reversal or change in the order of procedure is deemed advisable, it is important that these steps be constantly kept in mind and that each one be made as nearly correct as possible, if a perfect result is to be obtained. We will briefly discuss these various steps in order that the special procedures with reference to proper preparation for reception of the inlay may be brought out.

1. *Establishing the Outline Form*: The same rules for extension of cavity margins as are laid down for other classes of fillings are applicable here, including all fissures and deep developmental grooves in the main cavity, and extending all gingival margins under the free gingiva. The law of extension for prevention or "cutting for immunity," should be followed in all instances where no modifying conditions exist, but never should be carried to excess simply as a convenience form to facilitate withdrawal of the wax model. Access should rather be gained, as previously stated, through adequate separation.

2. *Removal of Decay*: Much of the decay has been removed during the performance of the first step. It should now be given thorough attention, the walls of the cavity closely scrutinized and cleared of all traces of carious matter.

3. *Giving the Cavity Form*: (*a*) *Convenience Form*: The major part of convenience form always should be gained through separation of the teeth and not through extension of cavity walls. No convenience points on the gingival or pulpal walls as for gold fillings are required or advisable.

(*b*) *Resistance and Retention Forms*: Lack of proper resistance form is one of the most frequent causes of failure of the inlay. As tested by the gnatho-dynamometer, the teeth, during mastication, are being constantly subjected to stresses ranging from seventy-five to two hundred and fifty pounds pressure, and in exceptional instances to as much as three hundred pounds. This being the case, it is necessary that the filling be as firmly seated as possible in order that these stresses may be resisted to the utmost. In all lines of mechanical work the general form of a cavity which is to receive an inlay, is the box or mortise. In this form all of the walls of the mortise present plane surfaces, joining each other to form definite lines and point angles. The mortises adapted for inlay work are the simple mortise on one surface (represented in *Fig. 1.*), and the compound mortise (step form) seen in *Fig. 2*. To facilitate withdrawal of the wax pattern the lateral walls may be very slightly flared outward instead of being allowed to remain parallel, as they would be for a gold filling. One or the other of these forms may be modified and adapted to the preparation of most inlay cavities. *Figs. 3* and *4* show examples of the

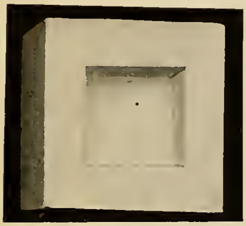

Fig. 1

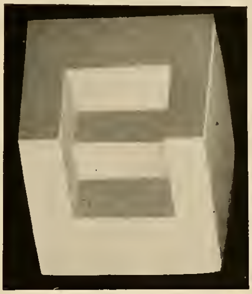

Fig. 2

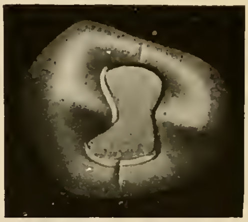

Fig. 3

Fig. 1—Simple mortise on one surface.
Fig. 2—Compound mortise.
Fig. 3—Occlusal cavity on bicuspid.

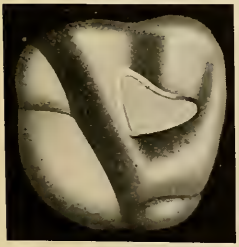

Fig. 4

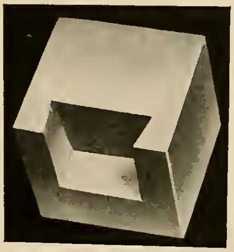

Fig. 5

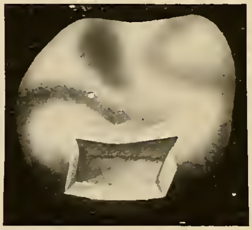

Fig. 6

Fig. 4—Occlusal cavity on molar.
Fig. 5—Simple dovetail mortise on two surfaces.
Fig. 6—Simple dovetail mortise on two surfaces.

simple mortise on one surface. The class of cavities represented are however, not ideal localities for gold inlay work and should be filled with cohesive gold. *Fig. 5* represents the simple dovetail mortise involving two surfaces, and *Fig.* 6 very clearly indicates the manner of its adaptation to proximal cavities on bicuspids and molars where the occlusal fossæ and grooves are not involved and the strength of the buccal and lingual walls will admit of its adoption. However, in the majority of instances of proximal cavities on anterior or posterior teeth, the compound dovetail mortise is ideal, resulting in locking the inlay into place so that it does not have to depend on the adhesive properties of the cement to hold it in position. Resistance form is gained by the use of the compound mortise (see *Fig. 2*) with its flat seat and plane surfaces, while retention is largely provided for by transforming it into the compound dovetail mortise, thus keying the inlay into position so that all lateral stresses may be resisted to the utmost. (See *Figs. 14* and *21.*)

In addition to the use of the dovetail, retention is in many instances accomplished by the use of 20-gauge pins of platino-iridium, platinized gold or gold-plated tungsten. Of these, the latter is much the strongest and at the present market price of platinum, by far the cheapest. In cases of vital teeth the pins may be placed on gingival, incisal and pulpal walls, as the case may be, paralleling them and making sufficient provision for easy withdrawal in the wax pattern; while in devital teeth the pulp chamber and the canal is utilized for this purpose. Accentuation of the gingival and pulpal point angles also may be resorted to for retentive purposes in many instances. The deepening of these point angles is not made at the expense of the axial walls, as is done for cohesive gold, but rather at the expense of the gingival or pulpal wall to allow for proper "draw" of the wax model. (See *Figs. 18, 20 and 23.*)

In all cases additional retention form may be provided by removing from the under surface of the wax pattern sufficient amount of wax to give the cement a better grasp on the inlay and also by undercutting the walls of the cavity for the same purpose. Instead of filling in undercuts in the cavity during its preparation with cement, it often will be found good practice to use for this purpose wax of a different color from that of the pattern. This may be made thoroughly smooth and oiled, so that the wax model will not cling to it during its adaptation and withdrawal. After the inlay is cast and ready for setting, this wax should be removed, thus affording additional retention by means of an increased body of cement. Wax may be used also for adaptation against weak buccal and lingual walls, to be removed just before setting the inlay, in that manner relieving the strain on these walls during the act of fitting and setting it.

4. *Beveling and Polishing the Enamel Margins*: There always has been much discussion in regard to the question of the advisability of beveling the enamel for gold inlays; some authorities advocating what is known as the "butt joint," while others as strongly advise beveling the margin. The chief disadvantage claimed for the enamel bevel is the increased difficulty of adaptation and withdrawal without marring of the wax pattern over long bevels. However, if one thoroughly understands the direction of the enamel rods in the various localities and the danger of fracture of the outer ends of these rods under the stress of mastication, there can be no doubt of the advisability of protecting these weak areas by strong bevels. In addition to the protection afforded the cavo-surface angle by an adequate

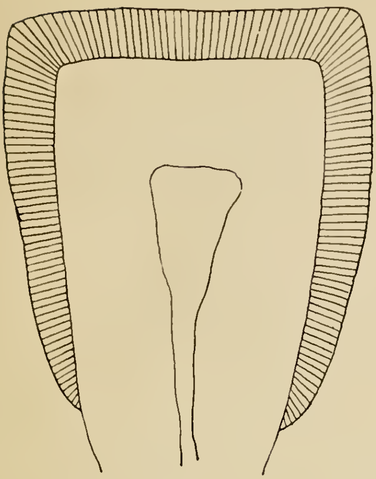

Fig. 7

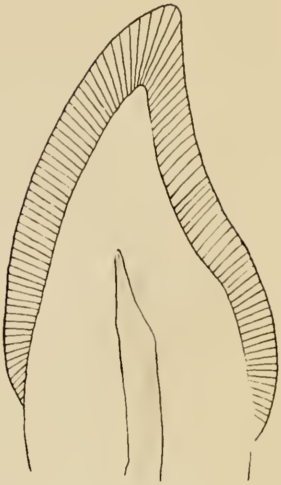

Fig. 8

Fig. 7—Diagrammatic drawing showing direction of enamel rods on a central incisor.

Fig. 8—Lateral aspect of same tooth seen in Fig. 7.

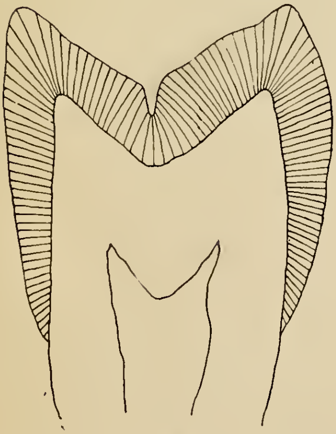

Fig. 9

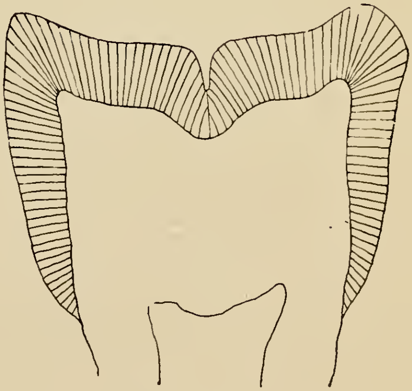

Fig. 10

Fig. 9—Direction of rods on a bicuspid.

Fig. 10—Direction of rods on molars.

bevel and the consquent over-lapping of the gold in these areas, another strong argument for beveling the margins is the fact that when the inlay is cast and seated to place, a thin, beveled edge will admit of thorough burnishing, the securing of a more perfect adaptation, and the elimination of the cement line—that weak point in inlay construction. If the cavo-surface angle be protected by the overlapping margin of the inlay, there is also much less danger of fracture of enamel rods during the burnishing process. *Figs. 7, 8, 9 and 10* show diagrammatic drawings of the direction of the enamel rods in various localities and accentuate the necessity for adequate beveling. The beveling should be done in most instances with chisels of razor-like sharpness. However, on buccal and lingual margins of proximo-occlusal cavities, the additional use of fine-cut discs often is advisable to produce a high polish and eliminate the tendency toward roughness of the wax model, produced by withdrawal of the wax against these rough margins. If this be not done and a high-power lens be used on the wax pattern, little projections may be seen pointing gingivally, produced by withdrawal of the wax against these roughened surfaces, resulting in an imperfect fit of the inlay. In beveling, the cavo-surface angle should be made obtuse and the bevel angle should not be very deeply buried, resulting in a long, thin bevel and a feather edge to the metal, which then may be readily burnished. The bevel should, in the majority of instances, extend about one-fourth to one-third the thickness of the enamel cap and should range from six to ten centigrades outward. *Fig. 11* shows the centigrade circle with the indicated bevel.

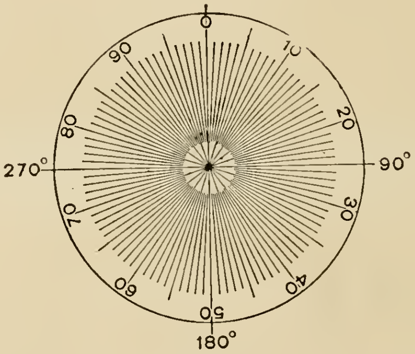

Fig. 11

Fig. 11—Centigrade circle.

5. *Performing the Toilet of the Cavity*: On the completion of the cavity preparation, which always should be conducted with absolute exclusion of moisture whenever possible, the walls should be thoroughly inspected for any remaining decay. All debris should be removed

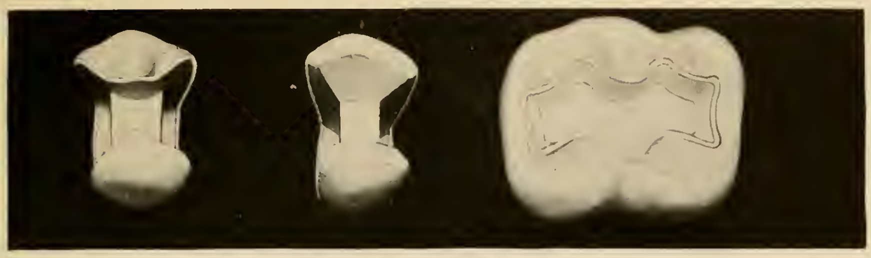

Fig. 12

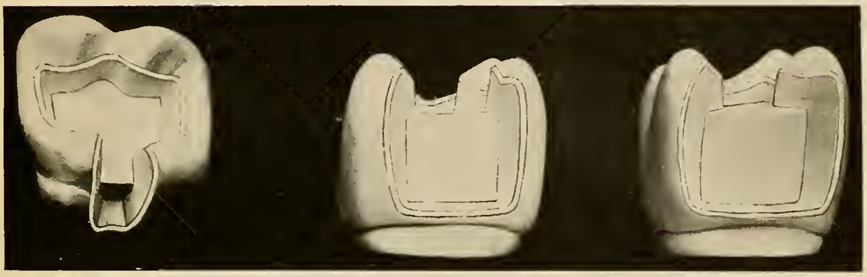

Fig. 13

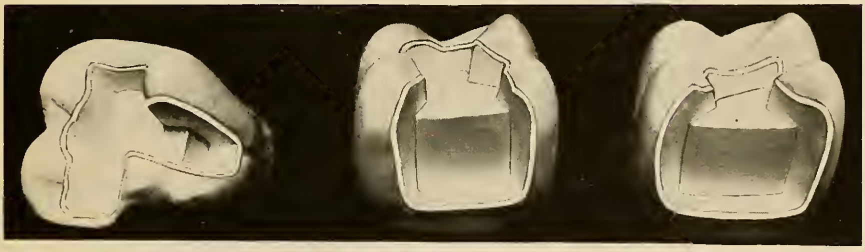

Fig. 14

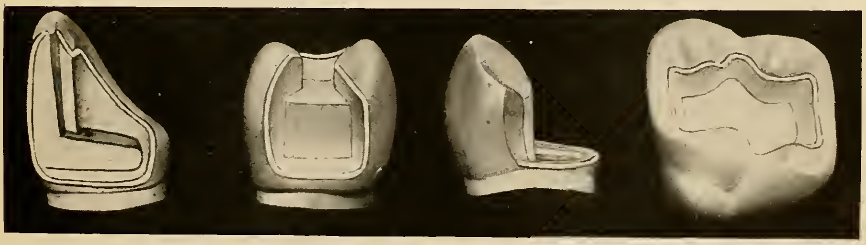

Fig. 15

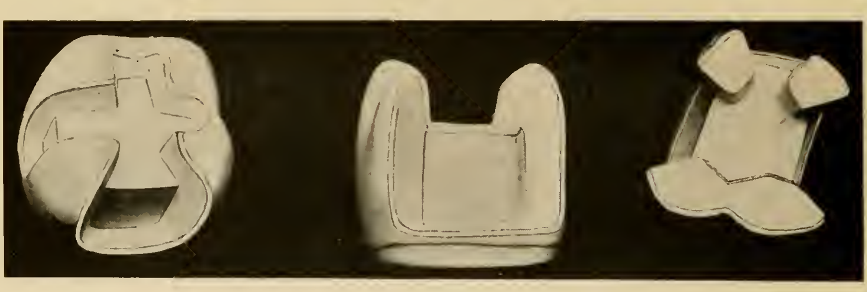

Fig. 16

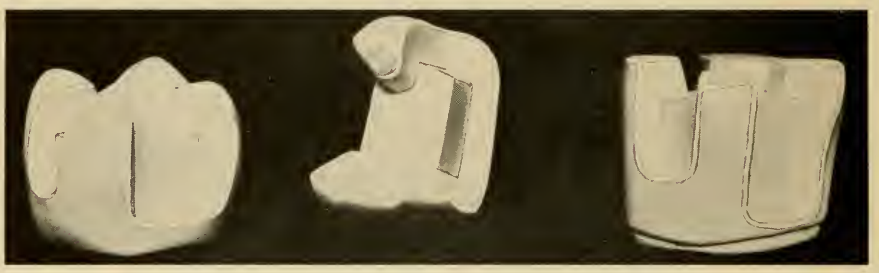

Fig. 17

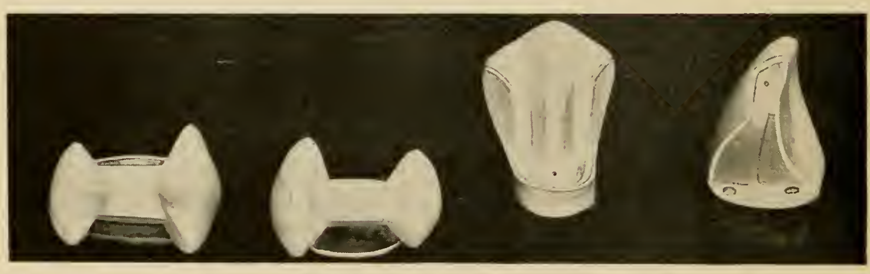

Fig. 18

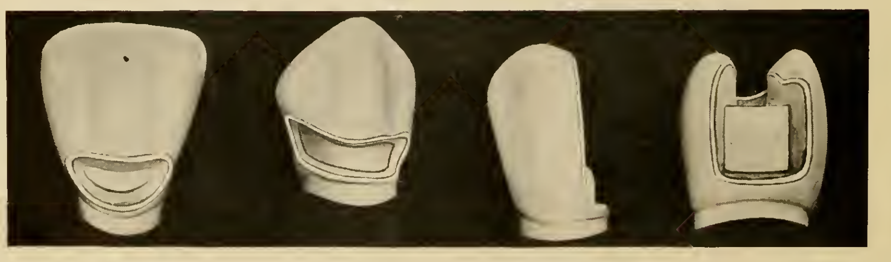

Fig. 19

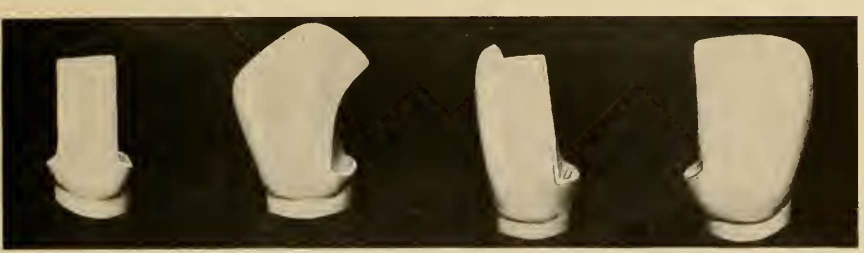

Fig. 20

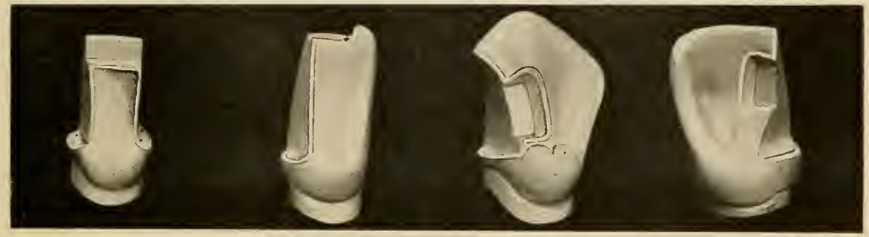

Fig. 21

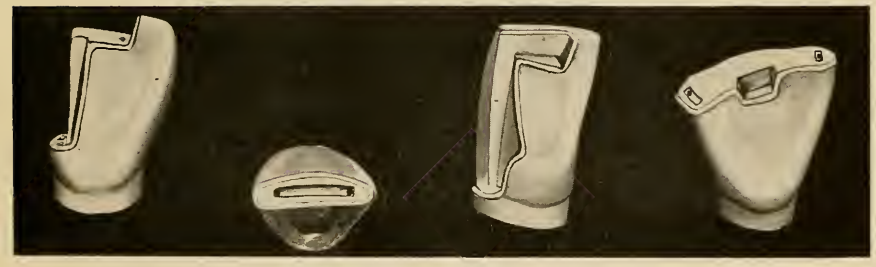

Fig. 22

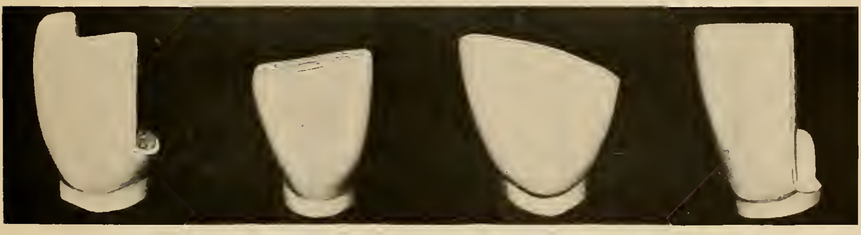

Fig. 23

with the chip blower and the walls thoroughly swabbed with dry cotton or spunk, after which the chip blower should be used again. After the wax pattern has been completed and removed, all traces of wax and salivary secretions should be removed with a bath, first of chloroform and then of alcohol. Herein lies the greatest weakness in the use of the inlay, since the most permanent results always are obtained if fillings are placed against freshly-cut surfaces. This latter procedure is obviously impossible in inlay construction, as it would destroy the perfect adaptation of the inlay and has of necessity to be dispensed with.

A study of the accompanying illustrations will elucidate the points brought out in the discussion of this subject. Most of the enlarged plaster forms and much of the artist's work on the photographs used for these illustrations are the work of Dr. Flora M. Hagg, to whom I desire publicly to acknowledge my thanks.

THE INDIRECT METHOD

BY WILLIS A. COSTON, D.D.S., TOPEKA, KANSAS

Since the introduction of the cast gold inlay to the dental profession, it has largely taken the place of the gold-foil filling and has made possible the filling and restoring of many broken-down and decayed teeth that otherwise would have been quite impracticable, and has made it possible to fill the ordinary cavity in a fairly durable manner. It will take a number of years of experience yet to determine whether the inlay is as good a tooth-saver as the foil filling, if it ever can be demonstrated, which the writer doubts.

The cast filling has saved many teeth in comfort for a period of years and has prevented thousands of cases of backache, nervous and physical prostration, and has made the practice of dentistry much easier and pleasanter than it was before for both patient and dentist.

A very fine technic has been developed, which, if followed, produces quite constant and very excellent results; as far, however, as the writer knows, no absolute knowledge exists as to the accuracy of adaptation to the walls of the cavity.

We say that inlays fit perfectly, which, of course, we do not believe, as perfection is not discernible, if possible. We do believe, however, that they can be made to fit approximately, say to within a few thousandths of an inch, maybe only one thousandth, which amount of leeway probably is necessary so that cement may be used between the inlay and cavity walls for the double purpose of filling the chink and preserving the dentin from decay. So we must not talk of perfect-fitting inlays, because, in the first place, perfection is not possible; in the second place, we could not recognize it if it were attained; and again, if it were attained, we could not properly seat our inlay, as the cement is supposed to occupy about one-thousandth of an inch space; and hence an inlay is not good because of perfection in fit, but rather because of its slight imperfection which makes it possible to cement it into the cavity, forcing it approximately to the seat designed without danger of splitting the tooth, which it would be very likely to do if it fitted the tooth accurately. And the slight imperfection is unquestionably shrinkage, which, if not scientifically demonstrated as an inherent physical characteristic of gold, has been many times clinically demonstrated; for instance, inlays may be and are cast hundreds of times daily, that with but little trimming and force may be satisfactorily seated, but overlays, bands, rings, crowns, cast in the same way are almost impossible to be forced into place. So manifest is this shrinkage that it is fatal, from the viewpoint of many men who make telescoping crowns, as the Peeso, to cast the contour over a strong 28-gauge coin gold telescoping band with the cap sweated on it, because it will not go to place after such casting.

Not only does the probable shrinkage inhibit perfection, but our human limitations, the possibility of slight changes in the investing material, in the drying and wax-evaporating process, in changes of temperature, may also be modifying factors.

If the foregoing theories are true, and perfection is not attainable, then the method that promises *good* results, that entails the infliction of less discomfort to the patient and makes the work easier and more definite, should be recognized as a desirable addition to the usual methods. However, even if I believed in the perfection of the cast gold inlay, I would contend that perfection is more nearly possible by the indirect than by the direct method.

Any man who has developed a technic that produces an inlay perfectly satisfactory to himself, would be very unwise to change it; and I am not attempting to proselyte, but am giving what, in my hands, from my viewpoint and with my limited ability, gives the best result. With this explanatory preamble, the principle reason for which is to impress upon you that, from the light given me, perfection is unattainable, we will take up the consideration of the indirect method.

Our aim is, of course, to make the best stopping possible for the cavity and restore lost contour. I will first consider several obstacles which may interfere with or prevent accuracy by the direct method of making wax models for the cavity, in the tooth, in the mouth. We see much beautiful and very accurate work made by the direct method in technic teeth *out of the mouth,* on the bench, unhampered by the conditons which prevail in the mouth; but the correct definition of the direct method, I take it, is the making of a wax model, that is, adapting the wax to the walls of the cavity in the tooth in the mouth, carving and trimming it to practical completion, then removing and casting; while the indirect method is making the wax model entirely out of and away from the mouth, casting and finishing even to its final polishing.

The obstacles are (as compared to the indirect method), inaccessibility, poor light, lips, tongue, saliva; the many times unease of the patient, the possibility of distortion in taking the bite; carving occlusally, as well as bucally and lingually and cervically; any or all of these. And it is sometimes hard to see, unless one's eyes are very sharp, a slight rocking or displacement of the wax in the cavity, due to carving and manipulating, when the chink or crevice is filled with saliva, which any one of you will concede who have made inlays out of the mouth. Then when it is transmuted into gold and seated in the cavity, the fit at the invisible margins, such as the cervical, sometimes under the gum, is quite problematical.

The finishing and polishing are done mostly after the inlay is cemented to place, which is disagreeable to the patient, and sometimes difficult for the dentist. All of these obstacles prevail, which do not obtain with the indirect method, and the result is not superior.

In describing the *modus operandi* of making an inlay, we will assume the cavity to be an M. O., or a D. O., which, after proper preparation (which does not differ from cavity-formation by the direct method), a substantial matrix is loosely adapted and held in place by a wedge, to prevent the modelling compound from being forced into the interdental space. Then a piece of modelling compound—pencil shaped and larger in diameter than the greatest diameter of the cavity—is thoroughly warmed on the sharpened or pencil-shaped end only, which is introduced into the cavity; the balance being more rigid, acts as a plunger or piston, and, under strong pressure, forces the softened compound into intimate, if not absolute, contact with all surfaces of the cavity, *when confined to the desired area with a matrix or band,* preventing its flow into the interproximal space or out around the cavity walls more than is designed, which matrix or band is removed with the compound (when chilled), and is, in fact, a part of the impression.

As no carving or trimming of any sort is done to this impression before its removal, the probability of distortion or change in form is not great, if the shape of the cavity is such that it will "draw," and if due care is exercised. It is quite resonable that such an impression will more nearly approach perfection than one made without a matrix, and which must be manipulated or carved before withdrawal.

The impression is then reinforced by being placed in plaster, which supports and strengthens any thin or weak portion and makes a cup or form into which to pack amalgam.

After the plaster has set, copper amalgam or any other alloy may be packed therein. The modelling compound, thoroughly cold, supported by the hard plaster, permits of considerable force, so that the amalgam can be thoroughly condensed. Very soft amalgam is used, especially for the major part of the filling, when the mercury may be expressed from the rest and packed until a first-class product results.

The resulting amalgam model should be, and is in fact, a very close duplicate in form of the cavity, including lingual, buccal and gingival walls, as well as the occlusal surface. Any material difference in form, granting good technic, would be on account of the change or condition due to the crystallization of the amalgam; and we are assured that there is none, and we know by clinical experience that, if any, it is negligible.

Copper amalgam is used in my office because of economy, as it may be used over many times, and principally because it seems to make the best model. Now, if the amalgam model is a duplicate in form of the cavity and surrounding walls, all difficulties about closely adapting wax to all the walls of the cavity, including the gingival margin, have disappeared, as we can hold it up in the light while sitting comfortably on a stool in the laboratory, *sans* lips, tongue, saliva, cheeks, vitality. We can examine it under a magnifying glass to discover rocking (and sometimes can succeed). To get the proximal and occlusal contact, an ordinary bite may be taken, and the amalgam model placed therein, mounted on a crown articulator, when the occlusion and proximal contact can be obtained with as much accuracy as they could be for a crown or bridge.

Not only is it an easy matter to force a cone of soft wax into the deepest recess of a cavity, but the wax can be extended to a feather edge over every margin, all in plain sight. the marginal occlusal ridges, the sulci and fissures can be carved to suit.

We need no argument to convince anybody that such carving can be more easily accomplished under such conditions than in the mouth. Even then many mistakes are manifest.

The wax can be removed from the model by attaching the sprue wire to the occlusal surface in the most favorable place, and carefully lifted out, invested and cast in the usual manner.

After the inlay is cast, it is cut from the nugget of gold, leaving enough of the sprue on the inlay to grasp with pliers. All investment is removed from it, preferably by immersing for an hour or so in hydrofluoric acid. All globules and imperfections are removed under a magnifier, and the inlay placed back in the amalgam model (where it will not go to place), as far as it will go without force. Then wrap in a paper and place it in a plane cylinder swedge between two good thick pads of unvulcanized rubber, and carrying it to a block, drive the plunger in, with a heavy blow or blows with a hammer; the rubber under the extreme pressure flows all around the model, supporting it against fractures, and the inlay usually is forced to place.

Inlays that apparently will not go half way to place without swedging usually can be driven home without fracturing the amalgam model, providing good-size models are made; and by using copper amalgam one can be very prodigal, as it can be used over many times without much deterioration. Such deterioration is caused by dirt, plaster and modelling compound being mixed with it, which can be cleaned out by rubbing the soft amalgam thoroughly in the mortar in an alcohol bath several times.

After swedging the inlay to place it is trimmed roughly and tried in the cavity of the tooth itself for proximal contact. When this is correct it is replaced in model, the sprue is removed and the occlusal surface (where the sprue was attached), is trimmed, then replaced in the tooth for testing occlusal contact. When correct it is replaced in amalgam model and finished completely. Usually an inlay so made slips easily without friction to its place in the tooth as an inlay should; and the fact that one is hard to force to place is almost conclusive evidence that it does not properly fit, as, for instance, a globule or two of gold on its surface will cause it to stick very tightly or make it impossible to be driven home, but is no evidence of a good adaptation. In swedging, small globules actually are flattened out or rubbed off and all the strain of forcing to place is in the model and not in the natural tooth.

It is much better that an ill-fitting inlay break a piece of amalgam and the process be gone all over again than that it split a natural tooth and possibly ruin it; and such things have happened. And so a method is advised that is sane and safe, where forcing an inlay to place does not endanger the natural tooth—when all grinding, sandpapering and finishing is done out of the mouth; but it does not claim to attain perfection.

INLAY GOLD

Coin gold is used by many operators for inlays; it is alloyed with copper and the formula never varies. It presents a hard surface which resists the force of mastication; it is easy to manipulate and makes an ideal casting. However, many dentists object to the reddish color of the copper and prefer the greenish color produced by a gold and silver combination, and it has been my experience that different patients will be better served by a careful selection of color, even in gold.—*Chester Charles Clark.*

FINISHING A CAST

In the act of polishing we easily can destroy the result of our effort so far; therefore the utmost care must be taken not to dull or polish away the margins. After the cast is ready for the lathe, use tripoli to remove the scratches; after this is done transfer to the rouge buffer and polish. For the final polish which will add luster, give it the acid polish. To accomplish this place the cast over the flame until cherry-red hot, plunge into hydrochloric acid, wash, dry, repolish lightly on the rouge buffer. Grooves and pits can be effectively polished with a proper-sized bud bur in the engine, run backwards.—*W. E. Mathison, Dental Review.*

CAST LINGUAL SPLINT FOR FRACTURED JAW

BY DR. H. R. ISENHOWER, BLOOMFIELD, INDIANA

The construction of the cast lingual splint is as follows:

Take the impression of both jaws and articulate the models as in making an interdental splint, with one difference: Make the model of the fractured jaw one-half pumice stone, one-half plaster of Paris. After the models have been articulated, remove the model of the fractured jaw from the articulator and trim well. Take a sheet of pink base-plate wax and fold a one-quarter-inch strip the full length of the sheet. Now heat the sheet of wax and press to place on the lingual side of the model of the fractured jaw and trim level with the occlusal surfaces of the teeth. Take a roll of wax and make a "Y" shape and attach to each side of the wax on the lingual side of the model for the place to pour the metal. Attach a small roll of wax to the heel of each side of the wax on the model for gates.

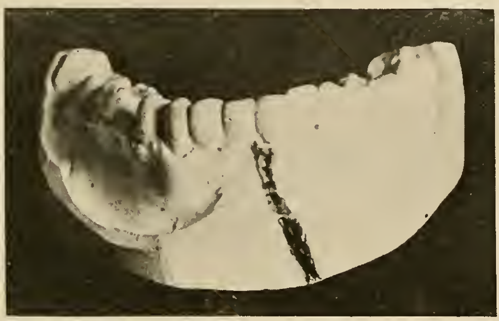

Fig. 1

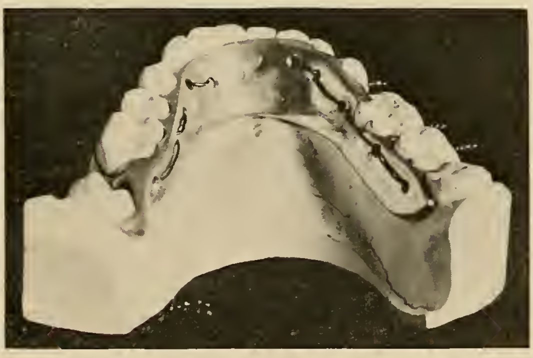

Fig. 2

Fig. 1 shows the case waxed and ready for investment.

Invest in an ordinary flask, omitting the cover and letting the "Y" shape and wax gates extend out of the investment.

The investment, one-half pumice stone, one-half plaster of Paris. After the investment has set, place the flask over a slow heat and burn out all the wax as in making an inlay. After the wax has burned out increase the heat and drive out all moisture. After the moisture has all been driven out and while the flask is hot, melt in a ladle Weston's New Metal and pour the metal into the opening that was made with the "Y" shape wax. Pour until the metal can be seen at the gate openings. When cold, remove the cast from the investment, trim and polish. Drill small holes at all of the inter-approximate spaces.

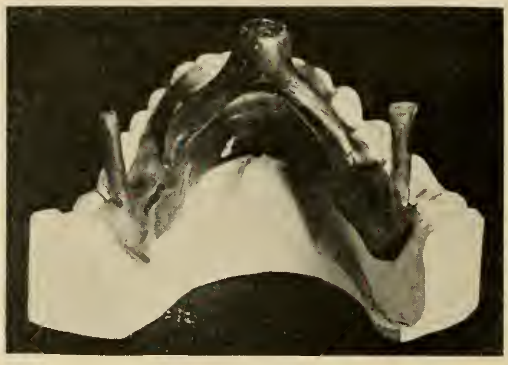

Fig. 3

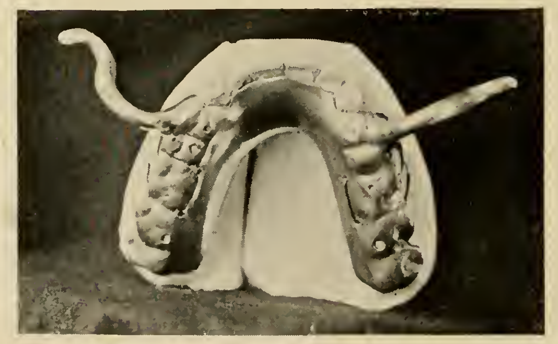

Fig. 4

Now the splint is ready to be placed in the mouth, and if each step in the construction has been carried out properly the splint will go to place and will restore the jaw to its original shape.

After the splint is in the proper place in the mouth, pass wire ligatures between the teeth, through the holes in the splint and twist them tight on the labial side of the teeth.

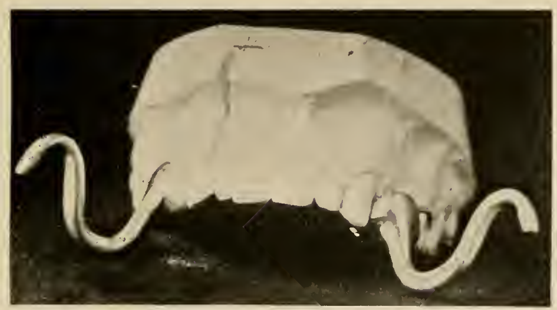

Fig. 5

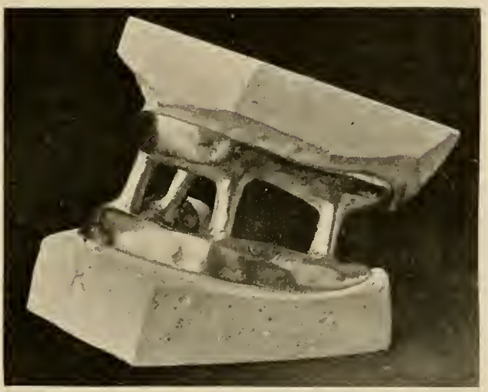

Fig. 6

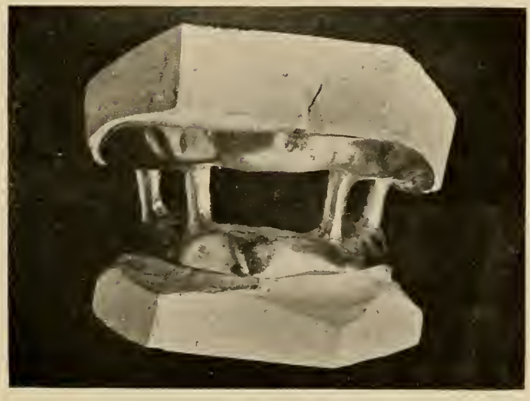

Fig. 7

Fig. 1 shows the line of fracture.

Fig. 2 shows the splint in place.

Fig. 3 the line of fracture.

There are several advantages of the cast lingual splint:

First: Simplicity, ease and time saved in construction.

Second: Good view in placing it in the mouth.

Third: Comfort and ease to the patient.

Figs. 4, 5. Cast splints for upper jaw. Made by same method as the lower cast splint.

Figs. 6, 7. Cast splints for either upper or lower jaw. For a patient who wears full upper and lower plates. Technic:—Make models of both upper and lower plates. Articulate the teeth on an articulator, remove the plate from the models, wax up and cast the splint as for lower splint described.

A SIMPLE FORM OF REMOVABLE BRIDGE WITH CAST CLASPS

BY NORMAN BEVERLY NESBETT, D.M.D., BOSTON, MASS.

INSTRUCTOR IN INLAY TECHNIC, DENTAL DEPARTMENT, HARVARD UNIVERSITY. SPECIAL LECTURER POST-GRADUATE SCHOOL OF DENTISTRY, COLUMBIA UNIVERSITY

The bridge about to be described is a type adapted to fill spaces caused by the loss of bicuspids and molars in either jaw. I make no claim that it can be used *everywhere* in the mouth to supply missing teeth. In fact, I believe no single system of bridge work is universal, despite the claims of its advocates.

This bridge, then, is a modified form of the old Bonwill bridge, using two stop-clasps, better known today as lug-clasps. Dr. Prothero, in his late work on "Prosthetic Dentistry," says: [1]"Without doubt this form of clasp, or some modification of it, in which the stop principle is embodied, is the most satisfactory and serviceable of any of the common types of partial-band clasps. By the addition of the stop, frictional wear of the enamel practically is overcome, undue pressure on the alveolar process covered by the bridge and on the gingiva surrounding the tooth clasped is obviated, and a feeling of security and comfort to the wearer of the bridge results, not possible to be realized from the use of the ordinary type of clasp. The credit of having evolved, demonstrated and described the practical applicability of the stop-clasp should be ascribed to Dr. Bonwill."

The appliance I am describing in this paper is the result of experiments begun late in 1913 to supply a missing tooth in my own lower jaw. After a number of spring-clasp and wire attachments had failed, I succeeded in making a bridge with cast clasps that has been worn with comfort and efficiency for nearly four years. That the dental profession was in much need of such an appliance has been best evinced by the interest shown since I began my experiments and first exhibited some completed bridges.

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[1] J. H. Prothero, D.D.S., Prosthetic Dentistry, Second edition, 1916, Medico-Dental Publishing Co., Chicago.

The appliance has replaced, in many cases, pieces of fixed bridge work and bent-clasp appliances, and in every instance the patient has reported more comfort and efficiency in chewing food. And, after all, you must realize that the patient has the final word on this subject. In the case of my bridge, I was the patient; so I *know.*

It has been my privilege during the three years I have been working out the technic of this bridge, to make them for several *dentists* to use in their own mouths; for the wives of several dentists, and for the patients of about twenty-five different dentists. I consider the report of some two hundred cases taken this way to be of more value than if they were all from one practice.

It has proved conclusively also that the indirect method used in making the bridge was successful, providing the steps were carried through correctly. In every instance where the practitioner has taken a correct plaster impression and obtained a correct bite, the bridge has gone to place with little or no adjusting and has been useful from the first hour.

INDICATIONS FOR USE

Cases with both abutment teeth sound, with hard, dense enamel, teeth usually badly tipped or out of line, or both; and with the dentist, and, more than probable in these days, the patient, averse to devitalization, are ideal ones for this method. Just these cases are the ones most of us have sidestepped without any attempt to supply a tooth, because we were not satisfied with any of the known methods of supplying that tooth.

The next indication for use is in places where a fixed bridge has been used—say, from first bicuspid to second molar—and like most fixed bridges, has begun slowly but surely to loosen the abutment teeth. The removal of the fixed bridge, placing of well-filled caps on abutment teeth, and substitution of a cast-clasp bridge will result in a tightening of the abutment teeth.

If this type of bridge is desired to be used on small teeth with thin, chalky enamel, with many fillings in place, it is preferable to make well-fitted shell caps and cement them to place before taking the impression for the bridge. The more the teeth are tipped the more this type of work is indicated, as it is a comparatively easy matter to cap these teeth individually—and an entirely different matter to attempt the parallelism necessary for a fixed bridge.

A particularly fine piece of work may be done by casting the caps with recessed places to accommodate the clasps and lugs, so that when the clasp is placed upon the crown there is no break in the outline of the tooth.

FIXED VS. REMOVABLE BRIDGE WORK

Taking all points into consideration, a removable bridge is the only sane appliance to put into the human mouth. It is my conviction that a removable type of bridge should be employed *whenever possible,* and that a fixed bridge should be used *only* where it is impossible to construct a *satisfactory removable* one. That I am not alone in my belief would seem to be borne out by the fact that several well-known dentists are wearing cast-clasp bridges to replace one or more missing teeth. It is interesting to note that not one of these men was willing to have a fixed bridge constructed for two reasons: *First,* because it involved more or less mutilation of two perfectly sound teeth; and *second,* because of the great difficulty, I might say impossibility, of keeping the fixed bridge perfectly clean. If we are not willing to put fixed bridges in our *own* mouths, why should we be willing to put them in the mouths of our patients? The Golden Rule is just as effective today, my friends, as when it was first written.

If we are to accept the tenet that nature knew what she was about when she so placed our teeth that every one is free to move slightly when stress is placed on it, then we must believe that some form of removable bridge work is indicated.

[2]"From a hygienic point of view there can be no question as to which is the best. It is impossible to thoroughly cleanse and sterilize any fixed bridge, as there is nothing which can be taken in the mouth that is of sufficient strength to perfectly cleanse and sterilize it without injury to the sofe tissues."

CONSTRUCTION TECHNIC

The construction, although simple, is not easy and requires the utmost attention to detail and care in every step of the process. [2]"The value of removable bridge work depends entirely upon the attention given to the numerous details and upon the *accuracy* with which the work is done. The fittings must be as nearly perfect as it is possible to make them; otherwise the work will not prove a success. The training which one gets in doing this class of work tends not only to make him more proficient in bridge work but more proficient in every branch of the profession, as the care and skill required develops a delicacy of *touch* and *exactness* in manipulation to a greater degree than does the ordinary routine of the dental work room."

PREPARATION OF TEETH AND IMPRESSIONS

The abutment teeth to be clasped are cleaned and polished and the occlusion noted, for space must be provided for the stops or lugs at *this time,* if it does not exist. Deep grinding is not necessary and is to be deplored, as it leads to rapid decay.

Next, an accurate plaster impression is taken, and this is the keynote of the whole process, for these clasps have practically an inlay fit; and *under no circumstances* should attempts at bending be made to correct any error in fit.

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[2] F. A. Peeso, D.D.S., Crown and Bridgework. First edition, 1916, Lea & Febiger, Philadelphia and New York.

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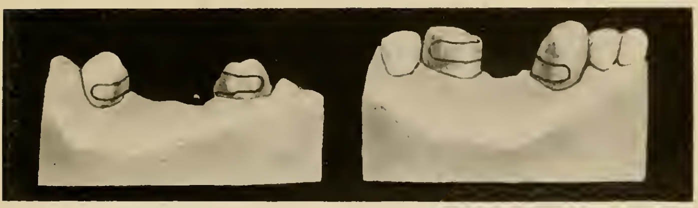

Fig. 1—Two cases with upper cuspids utilized.

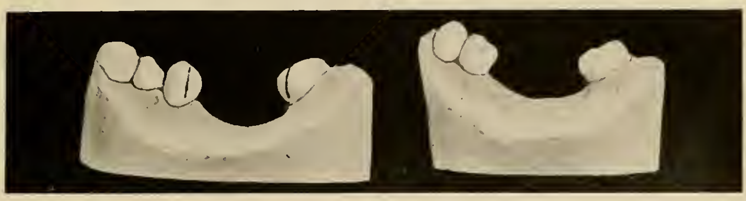

Fig. 2—Two cases with badly-tipped teeth.

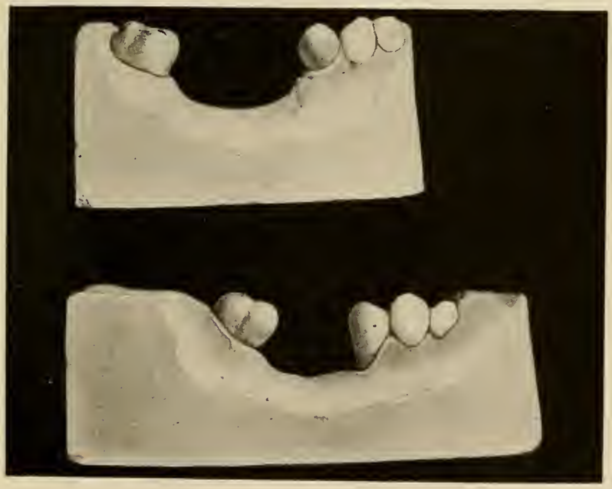

Fig. 3—Two long-bite cases.

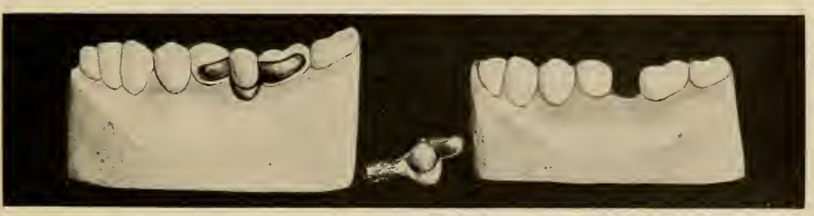

Fig. 4—Models showing appliance in use four years in author's mouth.

A small swivel crown-and-bridge tray is oiled and the impression plaster mixed much thinner than for other impression work, for we wish to obtain sharpness and definition in all our tooth-lines, and the stiffer mix of plaster will not flow into undercuts caused by tipping or leaning teeth. When the plaster has *started* to set, the tray is removed and the plaster scored at suitable points so that it can be removed in sections. Then the plaster is allowed to complete its setting to a point where it will break with a clean, sharp fracture. The resulting sections are then removed, taking care to preserve all small, but possibly important, fragments.

The impression plaster used is French's, as it is a standard plaster and runs fairly uniform. For such a thin mix a *hastener* has to be used, and I prefer a saturated solution of potassium sulphate (now $1.25 per pound; 15 cents in 1914). The proportions are as follows: Two F. drams or dessertspoonful pot. sul. to six F. drams or three dessertspoonfuls water. Add plaster as fast as possible with only enough stirring to avoid lumps. This mix gives but ten seconds working time for placing in tray and getting to place in the mouth, so you cannot travel all over the office with it before getting it to place. The oiled tray can be removed in twenty seconds; plaster scored in one minute—break and remove in two minutes.

A plaster mix made in this manner can be used as thin as will stick in an inverted tray. It takes every sharp line and holds it without "mushing," sets promptly and rapidly enough so that it usually can be removed before any great amount of saliva collects in the patient's mouth—a great advantage. It does not make a *strong* mix, but that is *not desired,* as such a mix *breaks out with too much difficulty.* A *prompt, firm setting, without great strength,* is what is desired.

Plaster is by no means easy to use and several impressions must be taken in some cases having long, tipping teeth, before one accurate enough to be used can be obtained. Under no circumstances should a poor or incomplete impression be used with the idea of correcting the defects in the model by carving, as failure or only partial success surely will result. Next, a modelling-compound impression of the opposing teeth, a small guide-bite in wax, and shade of teeth are taken. If this data is accurately obtained, the patient need not be seen again until the bridge is ready.

The plaster impression should be put together as soon as fairly dry, using the tray for a matrix or guide for the proper position of the pieces. Personally, I find it almost impossible to get the pieces in their proper places without some slight distortion, unless I place them in the tray and then secure them with sticky wax. The impression is then coated lightly with shellac; this dry, then sandarac varnish, being careful not to use either coating too thick. When the last coat of sandarac is thoroughly dry, the impressions of the two teeth that are to be clasped are packed with amalgam, first sinking small tapered metal dowels of rectangular cross section in the amalgam before it begins to set. Care should be taken to shape and smooth these dowels so that they will draw easily, and to set them as nearly parallel as possible, so that both teeth, no matter how badly tipped, can be removed in the same plane.

After the amalgam has set hard enough so that the dowels are firm, the dowels are *oiled* and the balance of the impression packed with Weinstein's artificial stone. Plaster can be used for this part, but the artificial stone gives a more satisfactory working surface. This new material—a calcium-barium-silicate—is an almost invaluable material for the crown and bridge worker. Models made from it are remarkably hard and durable and it possesses practically no expansion or contraction.

The compound impression is next poured and the two resulting models are mounted on an anatomical crown-and-bridge articulator, using the wax guide-bite to establish occlusal relations.

We now have a working model, correctly articulated, with two removable amalgam teeth, having their dowel pins in the same plane, so that both teeth can be removed freely.

The clasps are then outlined with pencil on the amalgam teeth and waxed up for casting as follows: A piece of thin sheet casting wax (No. 28 gauge) known as Solbrig's sheet wax, is warmed and adapted very closely to the *entire surface* of the tooth, which previously has been oiled slightly *between the lines marking the clasp outline only*. This wax matrix is then reinforced by flowing on Taggart's green casting wax to the desired thickness, which, of course, varies with the case. The pencil outline previously marked on the tooth can be seen through the covering of pink wax, and serves as a guide both for waxing up and subsequent trimming. After sufficient wax has been added and smoothed up, the tooth is chilled in ice water and the pink wax trimmed away to the desired outline of the clasp. A sprue wire is next attached, the wax again chilled in water and removed from the amalgam tooth. This has to be done with great care so as not to distort the wax pattern. With a little patience it usually can be accomplished and, if the waxing up has been done accurately and the wax pattern kept chilled, the two ends of the wax clasp will be seen to spring back to position as clasp passes over the slight bulge of the tooth. If the wax opens up and does not spring back to position, or if it is badly distorted in removal, do not attempt to place it back on the tooth, but wax up another. Any attempt at patching a wax-clasp pattern, or placing it back on the model after once removed, always results in a too loose-fitting clasp.

CASTING TECHNIC

Unless a technician understands a few fundamental principles as applied to dental metal casting, he cannot hope for much success in casting clasps. I speak of this because many batches of the casting metal have been returned to dealers as "scrap" because the dentists purchasing it did not understand the first principles of casting. I have used somewhat over fourteen ounces of casting gold known as the "E" formula, both experimentally and in practical cases, and never have

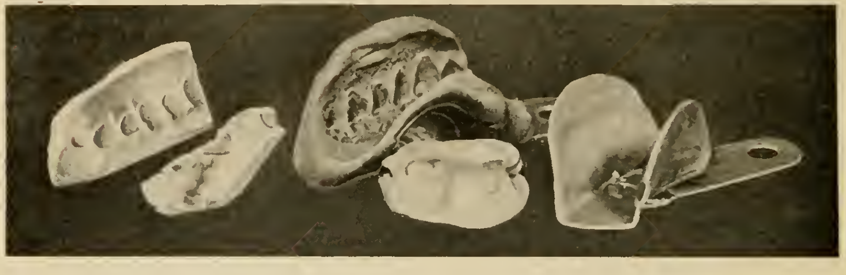

Fig. 5—Correct impression tray; plaster in sections; compound impression and bite.

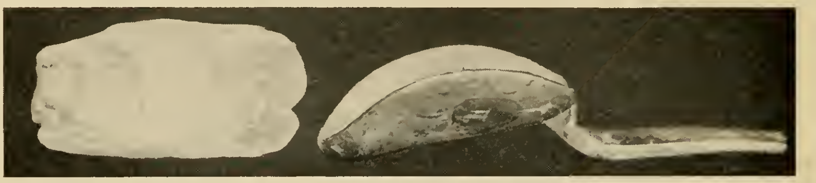

Fig. 6—Incorrect tray and wrong method of removing plaster in one piece.

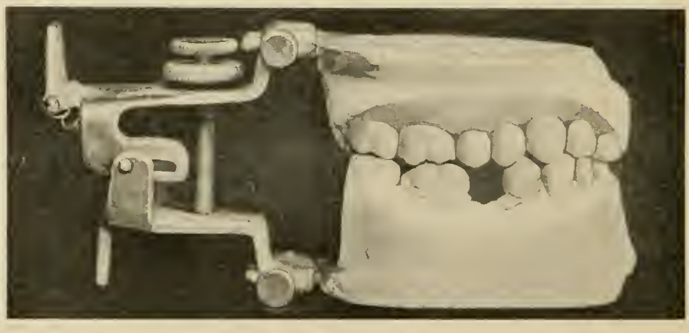

Fig. 7—Working model and appliance.

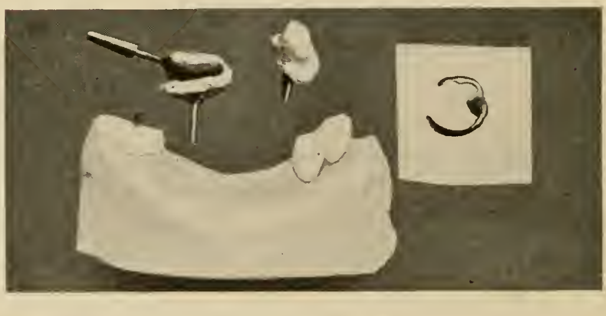

Fig. 8—Casting wax with Taggart sprue attached; removable teeth with dowel pins. Finished clasp at right.

turned back a grain to the dealers except in the form of filings and grindings. As a user and believer in the superiority of the Taggart process and casting machine, I use an *expanding* inlay investment, and cast in a cold mold, using *low* pressure for casting.

Following is my casting technic, used both for inlay and clasp casting: All work is done at as near room temperature as possible. I have found but few reliable *expanding* inlay investments on the market, so my choice is either Taggart's or Weinstein's formula. All investments are mixed in definite proportions by the use of the weighing device and the wax pattern invested as *soon as possible* after it is removed from the model to guard against possible distortion. Sprue sizes used are generally 16 or 18-gauge (B. & S.).

Just as soon as the "initial set" of the plaster in the investment has taken place the sprue wire is removed and the flask placed over a low heat to dry out. *In no instance* where an accurate fit is desired is the flask allowed to remain for longer than an hour before the drying-our process is commenced. [4]"It is hard to determine the actual principle involved, and it is not important to do so; but the fact does exist that castings made in a green mold, or one that is not allowed to air-dry, are more accurate than those made in an air-dried mold." In addition. under such conditions—air drying—the investment is very apt to crack or split upon heating (cause of "fins" on casting). Preparing a mold for casting should be done very carefully—as usually is *not* the case.

[4]"The initial stages of the heating should be at a temperature that will not permit the wax to run out of the mold, as it is important that the wax be absorbed in the mold. Forced heating and a generation of too much steam during the initial stages of the drying process will force the wax out of the sprue hole and produce a rough interior which. in turn, will show its effect upon the casting; the resultant casting being rough, incorrect and usually unfit for use." After all moisture has been driven off. the wax should be burned out as quickly as possible without over-heating the investment, which never should be brought up to red heat, bearing in mind that plaster decomposes and disintegrates at a temperature around 375 degrees F.

[4]"Prolonged heating of the investment after the wax has burned out is even more dangerous than under-heating. as plaster of Paris, which is the binder, *shrinks in proportion to the time that it is exposed* to heat." I repeatedly have dried and burned out a Taggart mold in twenty minutes, although from thirty to forty-five minutes is the usual time consumed. The flask is then allowed to cool so that it can be carried to the casting machine in the hand. For the average size inlay or clasp from three to three and one-half dwt. of metal are used, and great care is used not to over-heat the metal. [4]"While the ordinary gas-and-air blow pipe is capable of producing temperatures only somewhat beyond 2400 degrees F., it is possible to obtain without difficulty

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[4] L. J. Weinstein, Dental Metallurgy—F. A. Peeso's Crown and Bridge Work.

3400 degrees F. to 3500 degrees F. from nitrous oxid and illuminating gas, and over 4000 degrees F. from pure oxygen and illuminating gas. It is very difficut to avoid super-heating gold when applying such extreme temperatures, and great caution must be exercised by the operator. As a rule the cold flask is indicated when using extreme temperatures for melting the gold, because the gold melts very rapidly (fifteen to twenty seconds) and comparatively little heat is transmitted to the mold. The mold is then comparatively cool at the moment of casting, and even if somewhat super-heated gold is cast, it is not so apt to unite with the investment as when both the gold and the mold are super-heated."

[5]"It has been observed, when metals are cast at *too high* a temperature, or are allowed to cool *too slowly*, that the resulting crystals are of large formation, resulting in a weaker casting. This tendency in steel casting is known as 'myotism.' Casting in a cold flask is of great importance in clasp casting, as it cools the molten metal very rapidly, which as we have observed in the case of steel castings, results in a casting of greater density, strength and resiliency."

The casting pressures used range from two and one-half pounds for a small inlay to ten pounds for a large casting, where two or more pins are "picked up." About five pounds are used for casting most clasps. [4]"One of the most prolific causes, in fact, perhaps the *greatest* cause of faulty castings, is the excessive pressure used in forcing metal into the mold. The principal reason for this is that in a majority of casting apparatus there is no provision for obtaining a *definitely-measured and indicated amount of force.* It takes just so much and no more pressure to force gold into a given mold and hold it there until solidification begins. Excessive pressure will not, under ordinary conditions, prevent the normal contraction of gold, because the mold into which the gold is cast yields, and hence will distort in the same proportion as excessive pressure is applied. It may be true that a pressure of 2000 pounds per square inch may totally prevent contraction, but what would become of the mold?" [4]"*It is unfortunate that more operators do not realize the true value of an efficient casting apparatus, and the false economy resulting from the use of an intrinsically faulty or make-shift device.*" (L. J. Weinstein.) [4]"By using a grade of silica of maximum *expansion*, and a grade of plaster of minimum contraction, it is possible to produce an investment compound that will follow the flask walls when heated, and which will in some measure compensate for the two per cent. shrinkage of all castings."

CASTING METALS USED

A history of the experiments made to determine a suitable alloy for casting clasps might be interesting but not necessarily instructive. It took me two years, as alloys had to be tried out in actual use as well as in laboratory tests. For most of the metallurgical data and work I am indebted to L. J. Weinstein, of New York, a graduate of the School of Mines of Columbia University, and Director of the Columbia Post-Graduate School of Dentistry. The actual working tests in the mouth and the technic of clasp casting I had to work out myself. The clasp casting alloy that has been put on the market after exhaustive tests proving its worth, is a combination of an alloy known as "elastic" gold and No. 68 solder. The elastic gold gave good results but had too high a melting point which, as has been outlined, is detrimental if clean, sharp castings are to be made. Additions of the No. 68 solder lowers the melting point to 1945 degrees F., the same as pure gold, and the one part of zinc acts as a flux and makes a smoother casting alloy. [5]"This property of some of the lower-fusing metals to act as fluxes and deoxidizers, is utilized by sheet and iron founders, who often add a very small percentage of aluminum to their molten metal just before pouring, claiming that the metal so treated stays in a pourable condition much longer."

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[4] L. J. Weinstein Dental Metallurgy—F. A. Peeso's Crown and Bridge Work.

[5] Bradley Stoughton—"Metallurgy of Iron and Steel."

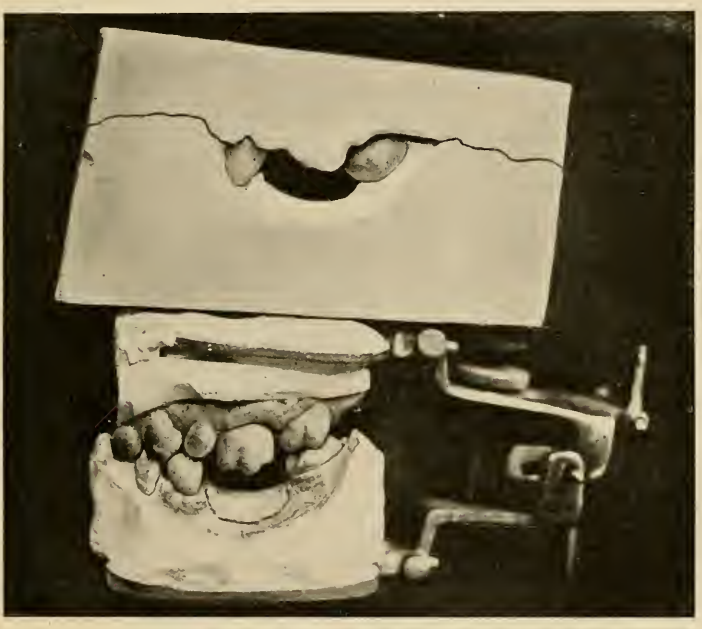

Fig. 9—Two short-bite cases.

Casting gold "E" can be cast perfectly in a *cold* mold, the resulting casting having sharp edges and remarkable freedom from flaws and pits It is very strong and tough, possesses spring and resiliency and best of all, *holds* that spring under use and under soldering conditions. It appears practically immune to temperatures below the melting point of pure gold. Other alloys tried were disappointing in this respect, as they either became extremely brittle under soldering heat or else softened considerably and lost their desired elasticity. In color it is a yellowish gray, hardly distinguishable from platinum, and its texture being very dense, it takes and holds a fine polish and like platinum, is unaffected by oral fluids. It will bend to a limited degree, but is not meant to be bent like other clasp metals.

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[5] Bradley Stoughton—"Metallurgy of Iron and Steel."

FORMULA

Gold	65.0	
Silver	4.0	
Copper	9.0	
Platinum	9.0	21.9
Palladium	12.9	
Zinc	0.1	
	100.00	

After casting, the clasps are freed from all adhering investment, boiled in acid bath, and all nodules and rough edges smoothed off. The clasps are then sprung onto the model teeth, and we are ready for the next step. I have used the Ash tube teeth in most of my cases, so I will describe their use. I prefer them because they enable me to use a maximum amount of porcelain with a minimum weight of gold framework, and when ground for correct shape and occlusion, they can be beautifully repolished. The Goslee teeth or the Davis crowns for metal work can be used to good advantage.

The middle section, comprising the saddle, cup for porcelain and post, is then cast. Usually I prefer to use for a post a piece of high-fusing clasp metal wire of No. 14 gauge (B. & S.), picked up in the casting and afterwards made doubly secure with a bit of solder. This middle section is cast with Ney's casting gold "B," the only variation in technic being that the casting is made in a hot flask, as by so doing a better union between the cast gold and the post or posts is more likely to result. After cleaning and pickling, this middle section is placed in proper relation to the clasps on the model, plaster relations of the parts taken, and the three parts assembled with one soldering. If the clasps are as accurately fitted as they should be, any very slight change during the soldering will disturb the relations of the three sections so that the bridge will not go to place on the model and the resulting appliance will not prove satisfactory. When the framework is found to fit the model as desired, the porcelain tooth is cemented to place and all metal work nicely smoothed and polished. Then final adjustments for occlusion are made, the ground surfaces of the porcelain polished, and the bridge is ready for the patient. As stated before, if proper care and attention have been paid to every step, the bridge should require but little adjusting at the chair.

This technic will not appeal to the man who wants "hurry-up" results, or who expects that this form of bridge, although simple, can be constructed for a *small* fee. A careful tabulation of working time required in an average case shows one hour of chair time to get data

Seventh: Is easy to repair should breakage occur.

Eighth: Can be constructed by any dentist with a good working knowledge of gold casting and soldering operations, who can construct a *well-made* fixed bridge; but cannot be "made to go" if carelessly constructed by the type of operator who cannot make a good fixed bridge, but who "gets away" with it because it can be jammed on with cement—and cement hides a multitude of sins—or did hide them until the radiograph came snooping along.

DISADVANTAGES

The disadvantages come under three heads:

First, and most important, is the liability of injury to the enamel surfaces under the clasps. We should select our cases for this appliance with great care, and not blind ourselves or our patients to the fact, long ago pointed out by Dr. Bonwill, that dissolution of the enamel and caries of the dentin will take place under this or any other type of clasp unless strict attention to cleanliness is observed. The fact that this kind of clasp does not allow room for any appreciable amount of food debris to crowd between it and the enamel should not lure us into a false sense of security when it is used on teeth of soft and chalky structure, or where the toilet of the mouth is neglected. I believe that with proper care and watchfulness on the dentist's and patient's part, time will show that no great amount of damage will occur under the clasps. And granting that it does occur, can it not easily be repaired with the many means that we have at our disposal? Surely such small damage that will come will be of less moment than the serious results that are coming from devitalized teeth, and of the two evils I am prone to choose the lesser.

Second: The second disadvantage is that which applies to all forms of removable bridge work, namely, absolute necessity for accuracy at every stage of the process. The success of the entire structure hinges upon the taking of a correct plaster impression to start with, and strange as it may seem, that has been the hardest thing to teach the practitioners desiring to learn this method.

Third: The third disadvantage also can be said to apply to other forms of removable bridge work, but possibly more so in the case of the clasp type. I refer to the liability of a patient swallowing one of the appliances. It is fairly easy to let one slip while removing or inserting it. I have not been unfortunate enough to have this accident occur to any of mine as yet, and caution patients to be careful—nevertheless it is an accident to be feared, as the results might be serious.

It would not be proper to dismiss this subject without a word as to the instruction to the patient as to the care of the bridge and abutment teeth. These bridges, when fitted properly, are so comfortable that cases have been reported to me by dentists where their patients had neglected to remove the appliance for cleaning for two weeks at a time. I consider this the fault of the dentist and not the patient, although some patients are poverbially lazy in this respect.

My patients are told very plainly that the penalty of any neglect in the care of teeth under the clasps will be carious teeth. They also are instructed in the care of clasps. Thus far, after a period of nearly four years, we are not seeing the rapid decay that some of the "wise ones" promised when I began my first experiments.

CAST GOLD INLAYS

BY M. F. BAUCHERT, D.D.S., EL PASO, TEXAS

In taking up the subject of Cast Gold Inlays, I am treating of a branch of dentistry comparatively new, although its introduction occurred slightly over ten years ago. Papers, demonstrations, arguments, clinics and experiments all have had their turn in demonstrating the technic and procedure of the different operators who have given the casting process their special attention.

I will not attempt to compare the different procedures of others, neither shall I present any re-hash of papers presented heretofore upon the subject, but give you as clearly as possible the methods practiced by me daily. To me the practice of dentistry is a part of my life from which I derive a great deal of pleasure; otherwise I could not have made cast gold inlay work a large part of my practice, for I know of no other branch of modern dentistry which requires so much care and precision as the proper preparation of a tooth for the reception of a cast gold inlay, the making of a correct model and the proper insertion and completion of the casting.

I took up the work of gold inlays shortly after its introduction. I attended a meeting of the New Jersey society, held at Asbury Park, N. J., during the summer of 1907, and where I had gone to recuperate from a severe case of typhoid fever; and where a lecture and table clinic were given on the then new invention. I do not remember who the demonstrator was, but I do remember that Percy Russell, who had just consolidated his New York business with that of the Electro Dental Mfg. Co., was at the meeting demonstrating a casting machine he was trying to perfect for the Electro Dental Co. and which evidently was never put on the market, and that shortly afterwards I rode with him upon the train from New York to Philadelphia, when the matter was discussed.

Reecntly I had my office assistant look back over my records and found that the first cast inlay I inserted was during August, 1908, and was of Klewe's platinum alloy; the first gold inlay I inserted during October of the same year, being cast of an alloy known as Manheim's gold, a formula given me by the Chicago man who came to Mexico selling a casting machine, and from whom I purchased my first casting outfit, which was of the compressor variety, which when well adjusted made a fairly good casting, and when not so adjusted, scattered about 80 per cent. of the gold over the laboratory floor.

and adjust bridge, with instructions to patient as to care of same, and from six and one-half to eight hours' laboratory time required. It will, however, appeal to any patient who has lost teeth through the failure of fixed bridge work, or who has sat for hours in a dentist's chair having his teeth and roots prepared for other forms of either fixed or removable bridge work. And in this strenuous era, the patient's time is a factor demanding some consideration.

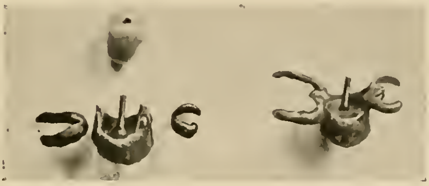


Fig. 10—Clasps and middle section; case ready to assemble (at left). Sections assembled (at right).

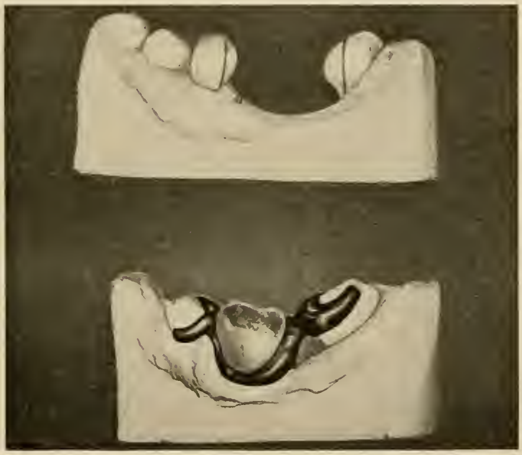


Fig. 11—Utilizing a leaning molar.

ADVANTAGES AND DISADVANTAGES OF THIS METHOD

First: No devitalization. We are living in an age of *prevention,* and any method conserving the vitality of the teeth is worthy of consideration. We need no more deliberately devitalize two perfectly sound teeth as often as has been done in the past, just to supply one missing tooth.

Second: No excessive grinding and mutilation of tooth surfaces, which often result in death of the pulp.

Third: An appliance that is simple for the patient to clean and care for, can easily be removed by the patient, boiled if necessary, and has no troublesome tubes, slots or sockets to be kept cleaned out, as in other types of removable bridges.

Fourth: Will stay in position *under service,* and is rugged and dependable under most severe conditions.

Fifth: Can be constructed with a minimum of nervous strain to the patient and dentist. As but two appointments are required, the dentist's operating time is greatly conserved.

Sixth: Is almost universal in application where indicated—that is, for posterior teeth, where there is a sound abutment at either end of the space.

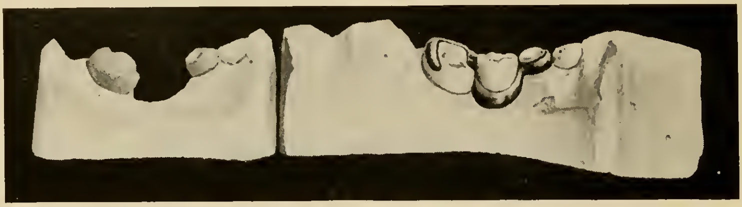


Fig. 12—Another type of leaning-molar case; lingual views.

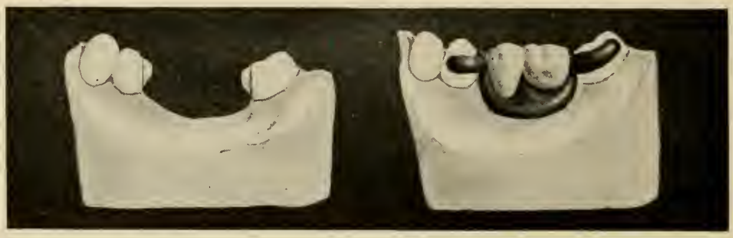


Fig. 13—A two-tooth supply with leaning abutments. Can be used for chewing all foods; sticky or otherwise.

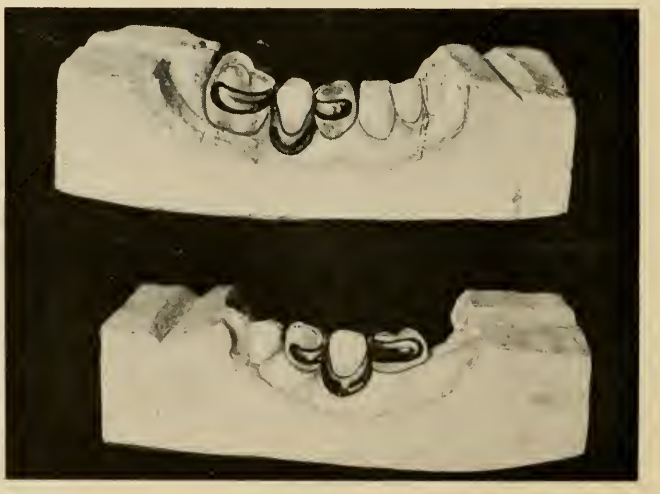


Fig. 14—Right and left sides of one-tooth supplies in same mouth.

directly under the cusps. When there is a dark reflection shown through the enamel at those points, the chances are that all decay had not been removed before the setting of the inlay.

Having removed all decay, study your tooth and its walls; see if there are any parts of the tooth too weak to undergo the strain required after the insertion of the inlay, and most especially that of pressure which might later be caused by the battering of a too prominent margin. When this has been determined, begin the formation of the cavity for the retention of your inlay, filling in the undercuts with cement—if such is indicated—but see that, in all circumstances and under all conditions, your cavity is thoroughly dry before inserting any permanent filling material.

This precaution is more necessary with inlays than with any other class of fillings, because your inlay must be so formed that it enters the cavity freely before being cemented; a damply-cemented inlay means decay and lack of retention.

Avoid burs with decided angles. Inverted cone burs in my opinion never should be used in dentistry in the preparation of cavities. Pear-shaped burs can be used in almost all cases where the form of an inverted cone is indicated.

MAKING OF THE WAX MODEL

A wax to be used for model making must possess the following characteristics: Be of such consistency as to permit of its manipulation upon heating in the initial formation of the model. at the same time be of sufficient strength and density to permit of its being carved when cool without dragging or changing its form; at the same time not be so brittle as to chip off in carving instead of giving a clean cut. Formerly and for many years I used The Ransom & Randolph Standard Wax and thought no other its equal; but finally every time I purchased a new supply it was put up in different form. About eighteen months ago I began the use of the Kerr Blue Inlay Wax. In this wax I found my ideal and in no way could I find any fault with it; its color was such that it permitted carving to a degree of nicety, indicating at all stages where care was necessary as to the thickness of the different parts of your model by the variations in the density of its color. Lo and behold! At the present time I am at sea as to a casting wax, for in the last dozen boxes of this wax which I recently obtained from our dental depot, I find an entirely new wax; so deep in color that you have carved through your wax before the color has warned you of the thinness, and so hard in composition as to be brittle at the temperature to which it cools in the mouth. The wax as formerly made could be formed ideally into the model, but now with large MOD cavities its manupilation is extremely difficult even to an experienced operator, where proximal margins are to be considered, as it hardens too quickly after insertion into the cavity and to such a degree that the proper adjustment to the margins is rendered difficult.

I do not like the re-heating of a wax in the mouth by warmed instruments, although at times I resort to it, taking care that my instruments are not heated sufficiently to melt the wax. I heat my wax over the alcohol or gas flame, causing it to melt and run, but in no case do I attempt to manipulate it until it has been thoroughly heated through and through and then cooled off enough so that when pressed with the fingers it is plastic without cracking or graining. At this point of temperature I calculate approximately the amount necessary to fill the cavity to overflowing, and just before inserting the wax into the cavity pass it through the flame, melting the outer surface. The instant it cools to the degree at which it will not crack through manipulation, insert it into the prepared cavity and press quickly to place. The outer part being so much softer enters all parts of the cavity, being forced into place by the less plastic and cooler inner portion, causing less distortion and a more concentrated mass. I then have the patient bite into the wax, thereby getting a perfect occlusion, quickly followed by repressing the marginal sections with a suitable instrument so that the wax is pressed into all depressions of the prepared cavity without any chance of rocking, holding the wax tightly in place with my finger during this part of the operation.

Now by the use of appropriate instruments I carve off roughly all surplus margins, avoiding at all times the use of instruments with very sharp edges, excepting when duplicating the natural tooth form as found upon the occlusal surface. If these sharp-edged instruments are used you are very likely to carve clean up to the marginal contacts, which should be avoided if a delicate and closely-fitting inlay is to be the result. For the proximal margins I take a rather fine cuttle fish strip, wide preferred, so as to overlap the margins in place of encroaching upon them, as might be the case with narrow strips, resulting in a grooved instead of a smooth and plane surface. I pass this wide strip between the teeth with the grit side toward the wax and then, while my assistant presses firmly downward upon the wax, I grip tightly the protruding sides of the strips and pass it back and forth over the proximal surface of the wax with the forces of the strips acting at angles of from 45 degrees to 80 degrees to the plane of the wax surface. In doing this the result is a slightly rounded surface upon this face of the wax model, and the wax is carried against your margins with absolute accuracy, producing that delicate overlapping of the feather edge of the beveled margins so much desired. To this I attribute to a great measure the success I have had with my inlays.

In stripping off this surplus wax care must be taken to avoid filling the grit on your strip to overflowing; pass your strip along to unused portions, otherwise your surface will not be smooth but have a grainy appearance with lines across it. During this initial stripping have your strip dry when possible, otherwise it is very likely to buckle. I now take a perfectly plain strip—a strip known as the amalgam strip, which is simply a good grade of tracing cloth—and placing the unglazed side toward the wax surface, draw it back and forth over the surface in the same manner as the previous strip and at the same angles of force, excepting that I permit this strip to become wet from

I had the pleasure during the past year of seeing the first inlay mentioned above in excellent condition in the patient's mouth; I also saw within the past sixty days the gold inlay mentioned, which was in perfect condition still. The Klewe alloy casting I removed by drilling in half, finding the cavity entirely free from decay. The patient had been coming to me off and on for some time, complaining that the tooth was sore and felt that something was the matter with the inlay. After repeatedly examining all margins with a fine explorer I would discharge the patient, telling her that I was certain the inlay was not at fault. Finally through her insistence I removed the inlay by drilling in half, finding the cavity in excellent condition and free from decay. This casting was a disto-proximal-occlusal one, and I attributed the long life of the inlay more to the cement used and the insertion into a dry cavity, than any special effort upon my part at the casting process. After removal I thoroughly examined the tooth and surrounding tissue for the cause of the soreness and found just under the gum margin and directly above the cervical border of the inlay cavity, a hard body, which proved to be about three-eighths of an inch of a wooden toothpick which had been broken off under the gum margin, or subsequently worked itself into that position. The patient remembered nothing of the occurence at the time it happened but the trouble at once disappeared. Upon meeting her husband some few days later he remarked, "my wife certainly has faith in you now although she was beginning to doubt you when you repeatedly told her that there was nothing the matter with her tooth." It was one of those cases which come to our attention and which we cannot at the time understand.

Returning now to the subject of casting machines. After my first outfit previously mentioned, I purchased the Elgin Vacuum machine and have used it continually since the day of its purchase, and as I have perfectly satisfactory results, I do not care to make any change. When I say "perfectly satisfactory results" I mean of course results which I feel are as nearly perfect as can be obtained by the present methods. I have argued with myself continually relative to different systems for casting, and when it comes to summing up the conclusions derived from the pros and cons, I find the Elgin in the front rank, and in my present paper all my casting methods and procedures are based upon its use. I have my reasons for adopting this machine, based upon scientific principles as applied principally through the laws of nature in physics and metallurgy, but I will not try to discuss them here, as my object in giving this paper is to present to you my casting methods, hoping by so doing to be of some material benefit to my fellow dentists.

My machine is the Elgin. My investment material is the S. S. W. My wax, Kerr Blue Inlay, which I must say is not at present entirely satisfactory, as explained later.

CAVITY PREPARATION

This is the most important and difficult part of the entire operation; the most severe for the patient and the most tiresome for the dentist. The margins must be perfect, and when your cavity is ready for the making of the model, all margins of the cavity must be in their finished state, for no change can be made in them without making the inlay absolutely valueless. Changes can be made in the body of the cavity by the careful and able operator, but those changes should not be made near any of the margins, and if by chance your bur should travel where it should not—as happens to all of us at times—cutting away any part of a margin, no matter how small, make a new model and under no circumstances try to remedy the evil, for it will mean a loss of time, failure in the end, and a twisted conscience for the operator.

A good patient trusts you; meet him half way.

In preparing a cavity there are times when the caries of the tooth leads into irregular channels, and if we should cut away all this decay before the taking of the wax model, we would not be able to withdraw it from the cavity, and to remove all decay before the taking of the model, at all times, would necessitate the useless destruction of tooth structure, or the extra work of filling in the undercuts with cement; for these small leads of decay at times are so small in volume that their removal after the taking of the model is of no consequence as far as the strength of the tooth is concerned.

The safer way is to fill in all these undercuts with cement and then re-form the cavity later and before the taking of the wax model. To do this at all times means a loss of time for the experienced operator. There is no cavity preparation to which applies the saying "Extension for Prevention" as to that for cast inlays; for the prevention in this case is not merely for the prevention of a recurrence of decay, but also for the prevention of the breaking down of your walls surrounding or underlying your inlay, in having undermined them too greatly in the preparation of your cavity and the removal of decay.

Take a careful survey of the diseased tooth and then with a sharp chisel cut away all overhanging enamel which your experience tells you must be removed. Remove this handicap at the beginning, and form in your mind a clear picture of the approximate form of the cavity necessary for the reception of the restoration.

In many cases that have been brought to my attention in which inlays have fallen out, I have found at first glance the cause of the failure which, in the majority of cases, has been a damp cavity or improperly-formed inlay. The failure due to dampness simply meant that the cavity at the time of the insertion of the inlay had not been properly dried out; that the dampness resulting from decay had been left in the preparation of the cavity.

If the overhanging enamel of a decayed tooth is not removed sufficiently to see when you have removed all decay, then your work becomes guesswork and uncertain as to its durability.

It is folly to make yourself believe that all decay has been removed simply because you cannot see it, for in the majority of cases where the distal and mesial surfaces are badly decayed, that decay has extended to the very apices of those projecting points of dentin found same into water and then into the remaining investment material in the rubber bowl and with a stippling movement paint it over my wax model. At first the investment does not readily adhere, but in a few seconds it will take hold and you can entirely envelop your model, care being taken not to have permitted any pockets to form during the operation. I then insert this wax model into the investment in the ring, lowering the same also with a stippling motion until it has completely sunk into the investment and the face of the crucible former in contact with it. I then press it to its desired depth and leave it for setting, which as a rule takes no less than half an hour. From this time on I do not take into consideration the passage of time within reasonable limits. If I care to leave it until the next day I do so and find no appreciable difference in my casting. From this point on all the work of drying out, initial heating before casting, cooling and subsequent casting, I leave to my office assistant; nevertheless this part of the operation in some respects is highly important, and I will explain some of the more important points. To remove the crucible former I hold the top a few seconds in the flame, but not long enough to melt the soft wax of the crucible former (never use hard or base-plate wax or modelling compound) and then I pry off the crucible former with my thumb-nail, the former generally coming off with all the soft wax, leaving a perfectly clean sprue in the investment. I then take a pair of pliers which I have for the purpose, and place their beaks in a Bunsen flame, heating them rapidly, then grasp firmly the projecting pin, retaining the hold until the heat from the pliers has transmitted the heat through the pin to the invested-wax model sufficiently for it to be softened at the point of its contact with the sprue. I then carefully revolve the pin to loosen the hold of the investment upon it and withdraw the same, leaving the hole leading to the model perfectly smooth and free from any projecting material. Sprues made from the bank pins as mentioned are brass, nickel dipped and highly polished. When you cut the pins into sprues, slightly round off the ends upon a fine wheel in your lathe or with a disc in your engine.

DRYING OUT THE MOLD

I now place the ring with the invested mold upon its side over a low flame inside of the closed half of an ordinary plate flask, placing the flame so that it strikes the bottom of the flask to one side of the place over which the ring is placed so as not to get too much heat at the beginning. In doing this the initial heating is very gradual, giving ample time for the investment to give up its surplus moisture; in this way there will be the least possible distortion of your mold. If quickly heated up I find that the mold contracts and cracks with some forms of castings, and the gold at times is cast into the minute crevices.

I allow about an hour to pass for this initial heating, if the castings are simple occlusal ones and not too large; but with large proximal and MOD castings about two hours are consumed. The ring is turned partly around from time to time. After this initial heating the flame is turned on so that the entire bottom of the flask is covered and the flame creeps up around the edges; leaving it about two hours longer as a minimum at this temperature, revolving the ring from time to time to equalize the drying-out process. After the minimum time has passed I pay very little attention to the time and have left them as long as an entire day and obtained perfect castings.

If the initial heating is carried out carefully, I do not believe that any subsequent heating affects them in the least, excepting that it betters them in the case of very large castings. Of course excessively high heats are not taken into consideration in my statements.

When I am ready to cast, I place the ring in an asbestos block retained for this sole purpose. If it is a block in which borax has been used in melting gold, etc., and any part of the borax attaches itself to the planed end of your casting ring, you will destroy its adaptation to the receptacle and make a failure of your casting, for perfect adaptation is necessary with the vacuum system. The large flame of the blowpipe is now thrown upon the entire ring, enveloping it completely, but taking care to heat gradually and evenly, revolving the ring from time to time. I continue this opreation until a cherry red shows through the sprue hole; then cut off my flame and leave the ring in the investment block until it is practically cold.

THE CASTING PROCESS

When the invested ring is cold I place it on the receptacle of the casting machine from which the air has been removed, then open the valve and see if the adaptation of the ring is perfect and air does not rush in except through the investment.

I now place my pure gold button in the crucible and heat as quickly as possible with the hottest flame (not a small pin flame) until the gold has melted and passed into the white dancing stage, when I open the valve and the gold is cast.

During this operation the investment directly surrounding the model cavity has not been heated sufficiently to retard the congealing of the melted gold almost immediately upon its contact with the investment. I believe upon this hinges a good part of the control which I feel I have mastered in reducing the contraction of the gold to the minimum, and the only contraction which takes place after the congelation of the gold is that which is natural to the gold itself, and which takes place between the temperature of the gold when cold and the point reached just before its fusion, which contraction is so small as to be practically nil as affecting the fit of an inlay. Even to try to control this contraction in pure gold would simply be an attempt at changing the laws of nature, which I do not believe any of us would feel like attempting.

My greatest results have been obtained in controlling contraction, since I realized that there are two distinct contraction stages. the stage between the molten gold and the congealed gold when it is at its highest temperature immediately after the congelation process has taken place, and the stage between this last temperature and when it is cold. In the first instance the contraction taking place is enormous. while with the oral fluids, giving the wax a smoothly-finished surface. In bringing your proximal surface to the desired adaptation by the use of these strips there seems to be just enough heat generated by the friction to soften the wax superficially, causing it to adapt itself with perfect accuracy to your tooth margins. After the adaptation of the proximal margins, I carve the occlusal surface, duplicating as nearly as possible the general form of the corresponding natural teeth. For this purpose the S. S. W. No. 33 and 34 scalers are very useful instruments, as the sulci of the tooth can be reproduced very nicely and quickly. In using these instruments I avoid permitting the sharp edges carving away all of the overlapping wax at the marginal points of contact, but trim these away with less sharp instruments as found among those used for plastic fillings. The formation of your wax model is now almost complete; but now comes the part which to me has proven of untold value in obtaining perfect adaptation and the elimination of any ragged edges at the marginal points of contact. I place the tip of my finger in the alcohol flame for a second or so and then quickly pass it to the tooth, and with a massaging movement, massage the margins of the wax, always in the direction of the exposed tooth structure and away from the body of the wax.

Your wax model is now practically ready for removal, but to insure that there has been no lengthening out of same, thereby causing it to rock or draw away from the margins, I generally take one of the plain strips and encircle the tooth, grasping the ends of the strip in the palm of my hand and with the tips of my thumb and index finger of the same hand tightly draw the strip around the tooth, at the same time pressing down upon the wax model with a finger of my other hand. Your adaptation is now perfect and completed, if your technic has been properly followed.

I now take a sprue made from an ordinary bank pin, which gauges about .035 inch in thickness, grasp it by one end with small pliers and hold in the alcohol flame for a few seconds, and then insert it in the wax model at a point generally of the most strength. This must be done quickly and steadily, as the wax is melted around the sprue, but congeals almost immediately, the pliers carrying away the heat very rapidly from your sprue, the very thing you desire, for in so doing your wax model has not been damaged or changed in any way detrimental to its fit. I generally have my assistant spray water of ordinary temperature upon the pin the moment she notices the wax has flowed around the pin and commenced to congeal, as it means a saving in time to the busy dentist. Now with a steady pull, directly parallel with your sprue, remove your wax model, being extremely careful that from that moment until it has been invested your model does not accidentally come in contact with any object whatsoever, for if it does, the chances are it will be rendered worthless so far as a perfect inlay is concerned.

I now carefully place the free end of my sprue wire in an ordinary jeweler's pin vise of the straight chuck variety, and with a small spoon excavator, perfectly straight excepting the angle at the bowl, which should be about 45 degrees, I groove the wax model around its interior surface in all places where retention is desired or suitable and the thickness of the inlay will permit. I have two objects in view when I perform this part of the operation; one being to form anchorage for the cement of my inlay, the other the formation of a thick body of cement near the exterior margins. I have noticed in many inlays which have fallen out, a black line following the outline of the exterior margins at the gingival point of contact with the tooth, indicating that dampness had enroached upon the interior surface of the inlay, either through deterioration of the cement or the inlay having been set without the cavity having been thoroughly dried out or protected against moisture during the insertion of the cement and inlay.

The use of this small spoon excavator forms minute feather edges upon the margins of this groove which are quickly and perfectly removed by passing another spoon excavator of a slightly larger diameter along the groove. Now if there is any surplus wax at the point of the insertion of the sprue wire into the wax model, I remove the same with a sharp instrument, this being the last stage of the operation; to remove it previously simply weakens the hold of the sprue to the model and many times permits your wax to break loose when carving the groove.

Your model is now ready for investment.

Carefully loosen the grip of the vise upon the sprue, and with a pair of small-beaked pliers firmly grasp the sprue, removing and inserting it into the conical wax of your crucible former.

At the point of entrance of your sprue wire into the wax, seal the contact with a hot spatula so that upon investing there will be no frail margins of investment to break off and drop into your mold, thereby ruining perhaps what otherwise would have been a perfect casting.

INVESTING THE MODEL

I take a small rubber bowl, placing in the same slightly more water than I judge necessary for the mix, adding thereto the investment material in loose form, slightly less in quantity than enough to take up the water. When the same has become permeated with the water, thereby expelling the air held within, I pour off the surplus water and thoroughly mix to bring to a homogeneous mass, expelling as far as possible all remaining air bubbles. I then strike the bowl upon the bench several hard and quick blows to bring to the surface any minute air globules or pockets. At this stage the mix should be of a consistency that it can be barely poured from the bowl with slight shaking. Avoid either too thick or too thin a mix, as I find that ofttimes either will result in a cracked investment. Having placed the inlay ring upon a glass slab, I pour the investment material into this ring, exactly opposite to the manufacturers' instructions, filling the same to the brim. Then after holding my wax model for a few seconds in a stream of water from a faucet, which will cause investment material to more readily take hold, I take a small camel's hair brush and dip the

In case the cavity is one in which the floor has been covered or the undercuts filled with cement, I take a round bur of suitable diameter and bur off a slight layer of the cement to remove any film or deposit which might have collected or formed and also form a groove in it corresponding as nearly as possible to that carved in the casting. These two procedures render the surface clean for the adhesion of the cement and a retention for the inlay.

I place the casting in pure alcohol and remove with my operating pliers, placing it in the flame of the alcohol lamp to ignite; then remove and permit the alcohol to burn off. After this I do not touch the casting with anything but the pliers.

I dry out my cavity thoroughly, and see that there are absolutely no damp margins, while my assistant is mixing the cement. When the mix is ready and at the proper consistency I take hold of the inlay with my pliers and slide it along the mixing slab into the mass of cement, repeatedly withdrawing it until the cavity surface of the inlay is thoroughly coated. In performing this operation all danger of air pockets is eliminated. I then take a small ball burnisher and with it carry a suitable amount of cement into the cavity, inserting from one side and gradually work it along the walls first, in order to avoid forming any air pockets, continuing until the entire surface of the cavity is covered. I then grasp my inlay with my pliers and carry it to its proper position, then press into place and seat with the aid of the mallet if thought necessary.

If for any reason your inlay has a tendency to rise when the pressure upon it is released, quickly remove it and do not attempt to remedy the error, for an air pocket has been formed and your cement at this stage is unfit for remanipulation, and you will only court failure in trying to remedy your evil. After removing wash the cement from the casting immediately and remove the fresh cement from the cavity of your tooth and repeat your operation from the first, as I have described. If you are not able to use cotton rolls or napkins with absolute certainty, resort to the rubber dam, but under no circumstances take any chances of subsequent failure through the insertion of your inlay into a cavity where any part of its surface contains moisture, as most failures can be traced to this as a primary cause, when not due to a faulty casting.

The cemented inlay is now left a few minutes with its margins covered with the surplus cement until the initial setting has taken place, then this surplus is removed. It is a good practice to leave the inlays until a future sitting for the final finishing. If the technic which I have given you has been faithfully followed there will be only microscopical margins of cement following the outline of your inlay, the removal of which is easily and quickly accomplished, as I will now explain.

FINISHING

When your patient returns, your inlay is in such condition that any force whatsoever necessary for its completion can be exerted without any danger of the inlay's removal. I now take an ordinary scaling instrument which has a V-shaped converging point and pass it around the margins of the inlay, removing all the fine margins of cement which are exposed to view. This operation also will remove the fine margins not visible to the naked eye.

You can now say that your inlay has a microscopical overhanging of the margins at their line of contact with the exposed tooth structure, and this margin easily can be burnished into place by a suitable instrument, thereby sealing completely any access of moisture to your enclosed cement, this being the final treatment which contributes greatly to the life of your inlay.

I now finish the surface of my inlay with plug-finishing burs, and when working on the margins always have the working contact of the bur revolving outwardly, as these burs act both as burnishers and cutters in their operation. They can be run backward with almost equal efficiency.

I never use stones because they cut your tooth enamel with more ease than they do the gold; where with the plug-finishing burs the enamel is damaged in no way, as the burs cut the gold very readily and evenly, but when arriving in contact with the enamel they refuse to cut it and you can tell immediately by the touch when this stage has been reached; these burs act also as burnishers in carrying the gold over and sealing the margins.

TO PREVENT CHECKING OF PORCELAIN IN CASTINGS

When casting on porcelain turn the investment over immediately so the bottom of surplus gold is excluded from the air, allowing the whole to cool evenly. The facing will not check when this is done properly. This also applies to solder work.

TO CLEAN A CAST GOLD INLAY

The cast inlay will at times have a deposit upon its surface that cannot be removed by the use of either nitric or hydrochloric acid solutions. These deposits usually are silicates or borax and can be removed with hydrofluoric acid. A fifty per cent. solution in water is the best to use for the purpose. It can be kept in a covered glass dish which has been coated with wax. Allow the inlay to pickle or remain in this solution for several hours, wash, and the inlay will be perfectly clean.—*F. W. Frahm, Pacific Dental Gazette.*

CASTING

To make certain that gold will adhere to posts (especially composition), flow a little 24-karat gold, by means of a blowpipe, where you wish the gold to adhere; then wax up and cast in usual way.

the latter it is extremely small. The former we can control as far as its effect upon the diameter of our casting is concerned, but with the latter our efforts are in vain. With the methods I have adopted and in many cases originated, the longitudinal contraction of the gold casting in MOD cavities during the second stage is in almost all cases a benefit instead of a detriment to the fit of the inlay.

If upon removing the casting from its investment, a perfect inlay has been obtained, quite a large hole generally is found in the casting immediately adjacent to the point of junction of the sprue wire and the wax model; the larger the hole in comparison with the size of the casting, the more perfect-fitting will be your inlay, showing that the contraction taking place during the congealing stage has been more perfectly controlled. This is based upon the laws of nature as applied in physics.

Now on the other hand the presence of this hole does not mean that your contraction affecting your casting has been controlled, for this hole can also be produced from other causes and represent a part of the congealing contraction taking place also in your button or surplus gold. Right here is where the principles of the pressure and centrifugal machines are at fault according to my deductions.

This hole can be readily and easily filled by first placing a little borated water into it with a pointed instrument and then heated to the fusing point of the borax, then filling the hole with either small pieces or filings of 22k solder. If you fail to heat the borax as stated, the chances are that the solder will be thrown out of the hole upon heating and flow into places where it is not desired. An adjustable Bunsen flame should be used and the flame selected large and entirely blue, although not of the blowpipe or regular Bunsen type, and being more or less equally hot at all points, thereby avoiding the possible fusing of your delicate margins. Place the hot casting immediately into dilute sulphuric acid and in doing so be careful not to injure your margins; if possible use iridio-platinum pointed tweezers which you can make, for if steel ones are used and they touch the acid, the probabilities are that your inlay will take on an iron stain, giving it a most undesirable color, which, however, can be removed by re-heating your casting to a red heat and again immersing it in the same acid, avoiding touching the acid again with your tweezers, which should have been entirely freed from the acid by washing in water before using the second time.

If any of the investment clings to the casting after washing with a stiff brush, by re-heating and immersing in the acid and repeating the operation you will generally remove the remaining investment or at least render it so that it can be washed off easily.

I do not like the use in open containers of such acids as hydrochloric—known as the most allaround acid,—neither nitric, for their fumes are very disagreeable and attack very readily any metals or nickeling in their vicinity. Neither do I like hydrofluoric with which the investment is most readily removed, as it must be kept in wax, gutta-percha or leaden bottles and its fumes attack glass and the porcelains, and a burn from it heals with difficulty.

Now examine your casting for minute globules of gold upon both the interior and exterior surfaces, and if found the former can be removed easily by a spoon excavator and the latter with a sharp chisel. These small cast globules are very small and can be avoided almost entirely if you are careful when investing your model to see that your investment is free from air globules and none formed during the investing process; nevertheless they are of no consequence and in no way interfere with the fit of the inlay if carefully removed. The large round lumps cast upon the inlays are either the result of a faulty investing technic or carelessness upon the part of the operator.

THE ADAPTATION OF THE INLAY TO THE CAVITY

I now cut off with wedge cutting pliers the inlay from the button, leaving about one-eighth of an inch of the gold sprue casting still attached to the inlay, to serve as a hold when trying-in the casting, which should fit at first trial, but make sure that it is properly seated. I take two blunt-pointed, long-handled instruments, placing one at a central point of the inlay and have my assistant strike this instrument a few sharp blows with a loaded gold mallet, having placed the other instrument at some other point on the inlay to serve in holding it down for the initial seating. I now hold the inlay down with the first instrument without removing or changing its position on the inlay, then place the point of the second instrument alternately upon different projections or wings of the inlay and each time having it struck a few light blows. You always can tell when the inlay is perfectly seated by the character of the effect of the blows. In doing this all rocking is eliminated if any previously existed, and the casting perfectly seated. This operation also flattens out any microscopical globules or raised margins caused by the carving of the retention grooves.

In case of large MOD castings I place an instrument upon each of the occlusal-proximal margins, inclining the instruments at such angles that the force of the blows will be directed toward the body of the tooth, holding down upon both instruments while each are consecutively struck a few light blows. This as a rule seats your casting in a satisfactory manner.

I now cut off the remaining part of the casting caused by the sprue hole, with wedge cutting pliers, and remove the slight prominence remaining with a suitable plug-finishing bur, wet. These burs will, if properly used, smoothly and quickly remove any surplus gold without jerking the casting out of your grasp and perhaps ruining your delicate margins as ordinary burs would do. Carborundum stones I do not like as they quickly clog up with the gold, rendering them unfit for the operation.

I now examine my cavity carefully to see if there are any remaining points of decay, either accidentally overlooked, or intentionally left in order to avoid undercuts. If so they are removed.

THE INDIRECT OR MODEL METHOD FOR INLAYS AND CROWNS

BY EDWARD B. SPALDING, D.D.S., DETROIT, MICH.

The term "Indirect Method" probably prejudices many dentists from attempting to learn the impression and model method. It suggests something lacking in accuracy, or else it seems too complicated or too time-consuming to deserve attention.

Instead of lacking accuracy, we feel it makes for better work, and when the making of correct models is learned, more and better inlay work will be done than by the direct method. This has been proven to the satisfaction of many successful men.

Dr. F. T. Van Woert prophesied some years ago that "unless some reliable and practicable method for the production of cemented fillings is secured it will suffer the fate of many other valuable discoveries and become a thing of the past." We believe the indirect method will be the saving of the inlay method to many of the profession at least.

It is not that the inlay lacks merit but the technic of producing accurate work when done on the tooth itself in the mouth is too exacting for the skill and patience of the average dentist. If, however, one attempt the impression method without first becoming acquainted with the principles of it, he is very likely to meet with failure and condemn the whole process. The principles are not obscure nor difficult to learn, but are more easily shown in clinic than described.

Those who have adopted the impression and model method are unanimous in claiming that it has been the means of improving their cavity preparation to a very great degree. It is difficult to be sure of cavity preparation, the lines in transparent enamel and the angles obscured in the shadows of a cavity in a natural tooth in position in the mouth, even when we have a definite form in mind. A correct model of a cavity shows us faults which we did not believe existed. In that way one soon learns to check up on his weak points and to study for better mechanical retention.

There are many advantages in the indirect method to both the operator and the patient.

The advantages to the operator are:

First: Shortening of operating time on the patient. We all know that the longer the operation on a single patient the greater the strain to both patient and operator. Two patients for an hour each are not as fatiguing as one patient for two hours, provided that the work is equally exacting.

Second: Comparative ease in obtaining a good impression of the cavity as against the more difficult fitting and carving of wax patterns or the burnishing of a matrix in the mouth.

Third: Better opportunity for occlusal and other anatomical restorations. It stands to reason that more exact and careful carvings can be done on a model which can be readily handled and observed than can be done on a tooth in the mouth.

Carving to restore sulci, marginal ridges, cusps and buccal and lingual contour are being deemed more and more important in tooth restoration, no matter what the material used. These anatomical restorations when done in the mouth require expert technic, and that is acquired by but few.

The articulated model in the laboratory makes this carving possible and comparatively easy to the average dentist or laboratory assistant.

Fourth: Not only the possibilities but the opportunity after the impression is taken to delegate the whole process of making the model and then the inlay or crown to a competent laboratory assistant, thereby relieving the operator of much laborious work which lessens to an extent the cunning of his fingers for operating. I am free to admit that a clever laboratory assistant who is devoting her time to the burnishing of matrices and baking of porcelain inlays and crowns, and the carving of wax forms for cast work, can outstrip me in the same work when I have divided my time beween that work and operating at the chair.

Fifth: When an office is equipped for the indirect method more and better work can be done each day than by the direct method.

Sixth: Ease in finishing and polishing gold inlays when done on a model.

Seventh: Much better margins and fit for porcelain inlays and porcelain jacket crowns.

Eighth: The opportunity to make corrections in a piece of work on the model, and if the piece is a failure, as sometimes happens, the model is a willing patient to submit to reconstruction.

Ninth: Operations which are difficult or even impossible by the direct method are comparatively simple by the impression and model method.

To the patient the advantages are chiefly two, viz:

First: The lessened time for operating directly in his mouth. There is no patient who chooses to have more work done in his mouth than is necessary.

The indirect method does lessen the time for the patient. After having work done by the indirect method a patient is very loath to submit to the direct method.

Second: It also eliminates much disagreeable work. It is much more agreeable for the patient to have an impression of an extensive cavity running beneath the gum margin taken with a properly-fitted matrix and modelling compound, than to have a wax pattern trimmed and finished along this hidden cavity margin.

Also the finishing of a gold inlay on the tooth in the mouth is a most disagreeable procedure for a patient, and when he finds there is a way to avoid it he is going to do so.

Today the public is aroused as never before to the necessity of caring for the teeth; consequently the demand for the services of the dentist is greater and there is being done more of all kinds of dentistry.

Discriminating people are on the alert to find better, more skilled, more "humanitarian" dentistry as they submit themselves for operations which a few years ago were considered unnecessary.

The operator who studies to improve his technic for the consideration of his patients soon finds his time filled to overflowing.

The indirect method is a great aid to humanitarian as well as skillful dentistry.

DIRECT METHOD OF MODEL MAKING FOR INLAYS

BY DR. G. E. BRATTEN, CINCINNATI, OHIO

In using the direct method of model making for inlays a great deal of difficulty is experienced in obtaining what would be termed a perfect model in wax. I have overcome a great deal of this by making small trays for each individual case with which to facilitate taking the impression from which the model is carved in the mouth. Take the copper cartridges which are used for swaging seamless trial crowns, and with scissors cut same to fit your case for impression. Soften wax as usual, place over cavity; then bring your improvised tray into position and with the fingers of the left hand on *buccal* and *lingual* flanges force wax to bottom of cavity. Cool and remove, when by examining your impression you will be enabled to see whether your impression has been carried to every angel of cavity; should you notice any portion of impression that has not been carried to the desired point add a little wax at that point and again force to position. When you are satisfied that your impression is correct, remove tray and placing wax impression back into cavity, carve to proper outline and occlusion directly in the mouth. In the final finishing of wax model use the thinnest ribbon saw to pass between adjoining tooth and wax model; follow with enamel linen strip, coated with oil of cajuput which will put a fine finish on model; with pledget of cotton saturated with some of the oil, refinish occlusal surface. Then model will be ready to remove and invest as usual. To secure a close, wedged contact, flow a little paraffin at point of contact, which will make finished inlay a little too large at contact, but will be easy to finish and make a perfect contact, which is greatly to be desired in a perfect inlay.

COMPLEX CAVITIES AND CAST RESTORATIONS

BY A. T. WILEY, D.D.S., TIFFIN, OHIO

The subject of this clinic was chosen to demonstrate a method of restoring to usefulness, (without crowning), a first bicuspid which had carried a compound approximo gold inlay.

The tooth had been attacked by caries through the faulty margin of the inlay, and in attempting to remove the inlay the whole palatal aspect of tooth was fractured, the labial wall alone remaining intact and apparently quite sound.

The tooth previously had been devitalized, so the removal of decay and formation of a flat seat at nearly right angles to the labial wall, and about level with gingivæ, easily was accomplished.

After beveling all margins, I took a modelling-compound impression of tooth and made an amalgam model. Over this I burnished and swaged 34-gauge, 24-karat gold with 7 per cent. platinum added, with the turned flange on the palatal, mesial, and distal aspects of cap burnished well over the beveled margins and extending under free margin of gum. This I placed in the mouth and inserted an iridio-platinum post of the length and size of the usual crown post, allowing post to project toward occlusal surface at least two-thirds of the distance. On this I built up and carved the desired restoration in the inlay, removed and cast with 24-karat gold.

The application of a combination of well-known principles has here produced the restoration of a first biscuspid to usefulness, and the labial wall having been conserved, the natural and therefore the most esthetic effect to be obtained has resulted.

The matter of "tipping" the labio-occlusal angle is one of choice depending on the judgment of the operator in each case in hand.

The cavity preparation is not always easy, but persistent effort usually is crowned with success, and it is worth the extra pains.

A CAST BASE FOR A PORCELAIN CROWN

BY G. D. EDGAR, D. D. S, DEFIANCE, OHIO

Prepare the root by cutting off at the gingival line and grind the labial surface quite short, and on the lingual surface make a groove with a "fissure bur" at the median line.

Prepare the crown by taking a knife-edged wheel and cutting a "V" on the lingual side; then insert post in the root and apply the warm inlay wax, pressing crown to place, trim away excess wax with spatula and apply the sprue wire at the lingual side where the groove on the root and the "V" in the crown meet, remove and cast.

When inserting the post in root, give it a rotary movement until you feel it drop into the groove, and the same with the crown.

The object of this is that you know to a certainty that your base is on the root and crown in the identical position of impression without great loss of tooth tissue.

THE CAST GOLD INLAY

BY M. H. DAILEY, D.D.S., PARIS, KY.

The cast gold inlay came to the dental profession like an earthquake, or a bolt out of a clear sky; indeed, it was a wonderful discovery. It swept over the country like a mighty wind and brought glad tidings to us all. Besides being a welcome announcement, the process is one of the most valuable achievements that ever came to the profession, and as a profession we quickly realized its possibilities and at once sought to avail ourselves of the benefits that surely have been ours to enjoy.

Most all the members of the profession immediately were like busy bees, inventing casting machines. All kinds, sizes, shapes and forms were soon on the market, and many of us were fast getting rid of our hard-earned cash trying to get the most efficient one.

If we compare the gold inlay with other filling materials and methods, unquestionably we must put it among the best (if not the best), especially under those conditions where our honest judgment prompts us to use it.

We believe it is possible to show greater skill, to more perfectly carve, contour and shape a gold inlay, to restore a badly broken-down molar and biscuspid, to combine strength and at the same time secure results that are pleasing to our patients with the inlay than with amalgam or any of the many filling materials in use today.

There are many things to consider when we are contemplating the use of any filling material: the patient's financial condition, what material will best preserve the tooth, what kind of filling will be easiest and at the same time most beneficial to the patient. If we are really honest, and if our experience really has taught us when and where to use the various filling materials, whether it be amalgam, malleted gold or the cast gold inlay, when properly chosen and installed each filling always will stand in our patient's mouth as a monument to our wisdom, honesty and skill.

The cast gold inlay should be used only when the operator's judgment prompts him that there can be placed in the cavity no other filling material that will do so much to preserve and save the tooth. We fear that the financial gain or difference in price may sometimes tempt us to use an inlay when the amalgam fillings that were perfectly satisfactory were taken out and replaced with gold inlays of an inferior character. That is, we believe, the worst kind of robbery. We see gold inlays placed in cavities where it was necessary to cut away and sacrifice much tooth structure. That is double robbery, getting the money and also the tooth.

The gold inlay is, we believe, most clearly and definitely indicated in restoring decayed molars and biscuspids, unless the cavities are small gingival or pit cavities, and in approximal cavities in molars and bicuspids where it would be a long, difficult, trying, tedious operation both for the dentist and patient to fill with gold foil, and where amalgam would be a hideous sight; in such cases, surely the gold inlay is indicated.

One of the good points in filling such cavities with gold inlays is carving the wax and getting a perfect point of contact. The possibilities of the gold inlay cannot be fully fathomed as yet, for each year its field of influence and usefulness widens; in the hands of the skilled operator we find restoration of cavities more substantial and very much more esthetic.

Then there are other cavities where the cast gold inlay may be used to better advantage than any other filling material; in lingual and buccal cavities where rubber dam, dental floss and clamps are most objectionable; also the distal surface of cuspids and in large approximal cavities of the incisors.

We find many times large approximal cavities involving the cutting edge which prohibit, I might say, synthetic porcelain, and where the time and nervous strain both on patient and operator in using gold foil would seem to us to be more than ridiculous now that the gold inlay has come to light. In cases of this kind it is just what we want; it saves the incisor and assures edge strength above any other kind of material. Therefore, is it possible to use any other kind of filling in as many different ways and be rewarded with results of such satisfaction and efficiency, as in the case of the cast gold inlay? Let us consider bridge work, with the gold crowns blinking and winking like lightning bugs. In many instances these can be made just as strong and infinitely more sightly by the use of the cast gold inlay.

It is quite true that we are having failures with the inlay, as well as success. Some men can get better results than others, but the same thing is true of gold foil. Where one may succeed with the one, another may succeed better with the other. However, we believe there are more dentists that fail with gold foil than with the cast gold inlay. The inlay is necessarily a laboratory product, a reproduction of a wax model, and gives a careless operator a better chance to "get by" with a filling that will be serviceable. The life of all fillings depends upon correct cavity preparation, and we would emphasize the importance of such preparation for a cast gold inlay if it be expected to give good and lasting service. Every step in the process of making the cast gold inlay, from the cavity preparation to the finishing and setting in of the filling, must be carefully and correctly handled.

TECHNIC OF A CAST GOLD INLAY

BY A. F. MILLER, D.D.S., SANDUSKY, OHIO

A cavity in the disto-occlusal surface of an inferior right first molar was prepared for a cast gold inlay in the following manner: The disto-buccal and disto-lingual margins extended to beyond the point of contact. All sharp angles and margins removed, except the gingival portion, at which point the surface was dressed off with a fine grit, hard rubber safety separating disk. This disk being flexible can be extended under the free margin of the gum with little discomfort to the patient. Excavation was extended to the occlusal center, cutting out the sulcus where carious, and so formed that the wax impression can be freely withdrawn. The above method of cavity formation presents two advantages: *First,* as retaining points for the inlays; *Second,* the removal of all sharp angles and margins that would be broken down in the mold by the action of the cast metal against them, thus preventing proper adaptation of the inlay to the cavity. This cause is often erroneously attributed to shrinkage or expansion of the metal. Gently warm the wax for the impression over a flame and press it into the cavity with the finger or flat burnisher, instructing the patient to close the mouth for occlusion. Trim off all excess, contouring where indicated, burnishing the wax over the approximal edges and carving flush to the occlusal margins. Chill the wax and carefully remove from the cavity with a small excavator. Carve a horizontal groove in the wax to give vertical anchorage to the inlay. This can be done more conveniently after the sprue wire is inserted. Heat and insert sprue wire in the approximal aspect of the model and secure it in its position in the sprue former with the point of a wooden tooth pick.

The first investment consisted of a small quantity of the investment compound applied with a soft hair brush, covering the model uniformly to about 1-8 inch thick, extending it down over the sprue former. This is then invested with a second mixture of equal parts of yellow molding sand and plaster, a little sodium chlorid added to hasten setting, and flasked in a split rubber tube secured from spreading at the bottom by the flange at the sprue former and by an open metal ring at the top.

After setting, the flask is removed and the wax and moisture eliminated by laying the investment horizontally on a wire screen over a flame on a case-heating stove and applying the brush flame from the blow-pipe on and over the end opposite the gate. This procedure required only fifteen minutes from the time the investment was set, including the casting, the inner investment showing no appreciable change from the high temperature to which it was rapidly subjected.

It is claimed by the demonstrator that the outer investment serves as a protective envelope to the inner against unequal expansion or contraction, thus resulting practically in an inlay uniform and without shrinkage.

The instruments used in preparing the cavity were Black's rapid excavator chisels, a short, right angle, fissure bur, two sizes, and fissure stone for right angle.

The inlay was cast on a vertical centrifugal casting device designed by the demonstrator.

The inlay was seated, and cemented in the cavity to which it showed perfect adaptation at every point.

PORCELAIN CROWN WITH CAST GOLD BASE

BY W. A. SANDERSON, D.D.S., PITTSBURGH, PA.

To make a porcelain crown with a cast gold base, proceed as follows:

Select a tooth of any make desired, either fixed or detached post.

Prepare root in usual manner, with a short bevel in labial, and a longer bevel in palatal direction. Grind crown roughly to place, leaving plenty of space between the crown and the end of the root on the palatal side. Mold a small piece of soft inlay wax about the pin and press to place or nearly so. Remove and trim away surplus wax. Warm slightly and press home. After again removing, be careful to remove all wax from face of porcelain, wipe it away with cotton saturated with alcohol or chloroform. If using detachable post crown, remove the porcelain, attach the sprue wire at the thickest point of the wax, viz., at the palatal heel. Also attach another wire (24 or 25 gauge) at a point as near the labial surface as is possible. When investing pass the second wire through a hole made in the side of the bucket for that purpose. After the investment has set, remove the sprue and both wires. The object of the second wire is to provide an escape for the air or gas which would otherwise be confined in the mold.

It will be found difficult to cast the gold to a thin edge without this provision for the escape of gas.

When using a fixed post crown, remember that it is impossible to overheat with natural gas and blowpipe, and the hotter the case the less liable is the porcelain to check.

After casting, smooth with paper discs and polish. The result will be a perfect adaptation to root and crown. In cases of enlarged root canal the wax and consequently the gold can be forced up on the post, thus giving extra strength and a perfect adaptation of the post to the root.

SHRINKAGE OF THE INVESTMENT—INVESTING THE WAX MODEL SO AS TO PROCURE THE MINIMUM POSSIBILITY OF DISTORTION

BY C. J. CLARK, D.D.S., CHICAGO, ILL.

The instability of the investment used for the purpose of forming the mold into which the molten metal is forced, has been considered the prime factor in many failures in the process of casting gold under pressure. It being charged—

First: That the investment being porous, allows the pressure to envelop the molten metal in the mold, causing distortion and augmenting the shrinkage of the metal.

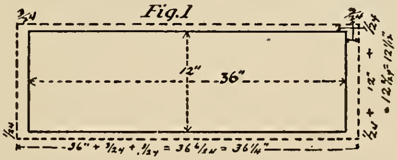
Second: That the investment is not of sufficient integrity to withstand the contact of the molten metal when considerable pressure is used to force the molten metal into the mold.

Third: That the investment shrinks, thereby causing a distortion of the mold.

THE POROSITY OF THE INVESTMENT.

The porosity of the investment can be considered as a detrimental factor only in cases where the force used to drive the metal into the mold is an expanding gas and in an extensive piece of work, the pressure not being restricted to exert its force on the metal in the crucible, but being free to penetrate the investment by virtue of its porosity, and to envelop and attack the metal on all surfaces, thereby causing compression from several directions, and must exert a deleterious influence on the finished product.

Fig.1



Before a cast is made the mold contains air, and when the metal is forced into the mold, it must displace the confined air and expel it into the porous investment, where it meets and offers opposition to and impedes the free expulsion of air from the mold, thereby retarding the ingress of the metal into the mold.

THE INTEGRITY OF THE INVESTMENT

When we consider the extreme fluidity of the molten metal, if judgment is exercised, there is no danger from this source; for the molten metal is in such a state as to be incapable of making any impression on the walls, angles and convolutions of the mold as it might if in a more coherent condition. The direct opposite is true, the walls, angles and convolutions of the mold imprint their very reflection on the surface of the molten metal, and unless an excessive force be used, there is no danger of distorting the mold from the impact of the molten metal.

THE SHRINKAGE OF THE INVESTMENT

Let us suppose *Fig. 1* to represent a bar of iron 36 in. in length and 12 in. in width, and of equal density throughout the mass. Under a definite degree of heat it will expand to the extent of 3-24 of an inch in each direction from its mean line of linear expansion and 1-24 inch in each direction from its mean line of lateral expansion. The dimensions of the bar would then be 36 + 3-24 + 3-24=36 6-24 + 12 + 1-24 + 1-24 = 12 2-24 or 36 6-24 + 12 2-24 as represented by *Fig. 1*. Now let us suppose that the same bar is bent into the form of a ring, the inner circumference of which would measure 36 in. with a consequent diameter of approximately 12 in. (The diameter of a circle being determined by dividing the circumference by three and a fraction, the fraction being omitted to simplify.) The dimension of the outer circumference is immaterial. Now if the same definite degree of heat be applied as was to the straight bar, we will discover that while the dimension of the outer circumference has increased, the dimen-

Fig.2

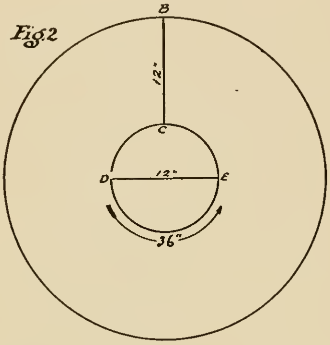


Fig.3

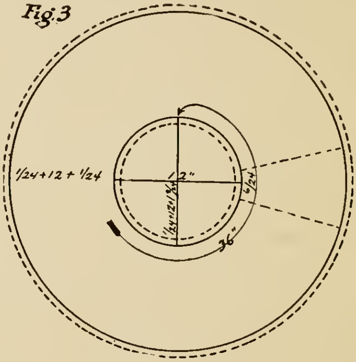


Fig.4

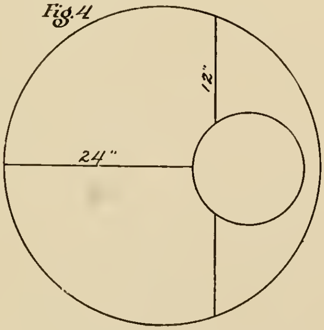
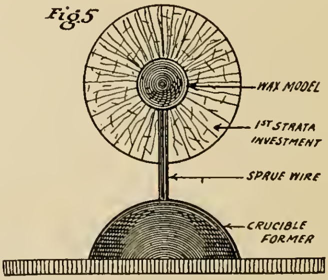
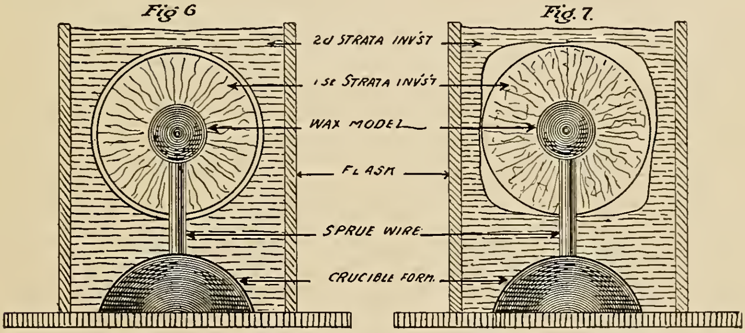


Fig.5



sion of the inner circumference remains unchanged. For the simultaneous increase of the outer and inner dimension of the respective circumferences, without taking into consideration the lateral expansion of the ring, would form a ring the inner circumference of which would measure 36 6-24, with a resultant diameter of 12 2-24 (*Fig. 3*). But the lateral dimensions of the ring are increased by expansion to the extent of 1-24 inch in each direction from the mean line of lateral expansion (see *Fig.* 3 and note dotted lines), thereby increasing the lateral dimension of the ring toward the center of the inner circumference, thus decreasing the dimension of the diameter 1-24 inch at any and every point on the inner circumference of the ring, or 12 2-24—2-24 = 12 in., the 2-24 decrease in the dimension of the diameter due to lateral expansion, offsetting the 2-24 inch gained by the 6-24 inch increase of the circumfernce. Therefore, the diameter of the inner circumference will measure 12 in., being identical to the measurement of the diameter before expansion occurred. Thus, when the lateral measurement (*B. C., Fig. 1*) of an iron ring equals the diameter of the inner circumference of the ring (*Fig. 1 D. E.*) should any expansion or contraction occur, the dimension of the diameter of the inner circumference remains unaltered. Let *Fig. 4* represent a ring, the circumferential dimensions of which are identical to *Fig. 2,* but with the inner circumference eccentric to the outer circumference to the extent as shown in *diagram* 4. The lateral dimensions of the ring being no longer uniform, should any expansion occur, it would vary in proportion to the changing lateral dimension. Thus, where the lateral dimension measures 24 in., the expansion would be 2-24 in. in each direction from the mean line of expansion or an expansion of 2-24 in. toward the center of the inner circumference, which would cause a decrease in its diameter of 2-24 in. at that point; and where the lateral dimensions measure 12 in. the expansion would cause an increase of 1-24 in. in each direction from the mean line of lateral expansion, with a corresponding decrease of the diameter of the inner circumference at that point. Therefore, the lateral expansion would be of an unequaled and varying degree throughout the ring, registering the same varying degrees of inequality upon the inner circumference of the ring. Hence,

Fig 6 Fig. 7



the inner circumference would no longer maintain the lines of a perfect circle, and the ring would be described as having become warped and the inner circumference distorted.

Now these same laws which govern the expansion of an iron ring, are also applicable to contraction, and also to any substance capable of exercising the property of expansion or contraction. For instance, investment material would be included, it having a tendency to shrink under the application of terrific heat. Suppose we desire to cast a perfect ball; if the wax model was surrounded by an investment of equal consistency, held by a flask in the form of a globe (*Fig. 2* could be applied as cross section), and the thickness of the investment equaled the diameter of the wax model, should expansion or shrinkage occur, the dimensions of the mold would remain unchanged. Again, suppose we desire to cast a perfect ball, but the model is placed eccentric to the external surface of the investment (to which *Fig.* 4 could be applied as a cross section) so that the investment would be of unequaled and varying thickness, then should any expansion or contraction occur, it would be unequaled in proportion as the lateral dimensions are unequaled and the effect would be registered on the walls, angles and convolutions of the mold, and the investment would be described as warping, and the mold as being distorted. Now again, let us suppose it is desired to cast a perfect ball, but in an ordinary flask used for dental purposes. Now, if the wax model is attached to the sprue wire and mounted on the crucible former, and the model encapsuled by investment of uniform thickness, equal to diameter of the model, (see *Fig.* 5) and after this has crystallized, place the flask over it, and completely fill it with investment material. (*Fig. 6*). Then should any shrinkage occur during the process of obliterating the model, or fusing the gold in the crucible, it would be incapable of exerting any deleterious effect on the mold. And for this reason—that the continuity between the first and second stratum of investment is broken, and should any shrinkage in the second stratum of investment occur— it being of unequal thickness— the effect of the shrinkage on the mass would be unequaled; but the continuity between the first and second stratum being broken, the second stratum would draw away from the first stratum, causing no distortion to it (the first or inside stratum) ; and should the mass comprising the first stratum subsequently shrink, this mass being of uniform thickness and equal in measurement to the diameter of the model, should any shrinkage occur the form of the mold would practically be unaltered (*Fig. 7*). Hence, during the process of investing a model for the purpose of making a matrix or mold for the casting of gold or any metal under pressure, if the model is encapsuled by a stratum of investment of uniform thickness and equal to the thickness of the model, and be allowed to crystallize, and then this surrounded by the flask and enveloped by a second stratum of investment, it is, for all practical purposes, a geometrical impossibilty to distort the mold, should shrinkage of the investment occur. The operator can exercise his ingenuity to an unlimited degree in investing to the best advantage, models taken from compound approximal cavities including occlusal fissure cavities and copings, so that only an infinitesimal degree of distortion can possibly occur, should the investment shrink or even check.

A THEORETIC CONSIDERATION OF THE EXPANSION AND CONTRACTION OF GOLD WHEN CAST UNDER PRESSURE

BY C. J. CLARK, D.D.S., CHICAGO, ILL.

One of the perplexing questions that has confronted the dental profession and been the subject of controversy and discussion since the process of casting metal under pressure has been practiced, is the question of shrinkage and expansion. Of all the literature I have read pertaining to this intricate subject I have, so far, failed to find anything that gave a correct exposition of this question, or depicted a true scientific portrayal of the metamorphosic phenomena the metal undergoes in its transition from the molten to the solid state.

I have read ably written papers comparing the shrinkage of gold when cast under pressure, to the shrinkage of steel rails. I have perused columns of figures, carefully compiled, showing the degree of expansion and contraction of gold under normal conditions, but this is immaterial and not applicable; on the contrary, it is flagrantly fallacious when applied to gold cast under pressure, while the molten metal is confined within the unyielding embrace of rigid walls.

Of all the mechanical achievements that man can boast, there is not one that is not a modification of some mechanical principle utilized in the unfathomed laboratories of nature. In regard to the art of molding and casting, the same cosmic laws prevail with infallible accuracy, whether the proportions are the seething molten mass of an uncooled planet, or an insignificant globule of gold no larger than a pea. Science teaches that the planets and all the solar system once existed in the form of nebulous or gaseous matter, scattered throughout the boundless oceans of space, whirling and revolving, gradually cooling and growing denser, throwing off portions from what we may term parent bodies, and these cast off portions in turn throwing off other portions from their mass, until this sort of process in time evolved our solar system.

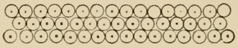
So for countless ages the matter of this earth existed in a molten state, gradually cooling and shrinking until the surface became rigid and the internal molten mass became encapsuled by a crust. As the shrinkage continued, matter was called upon to supply the deficiency, and the crust being solid and rigid and held by the power of cohesion, the power of centrifugal force was greatest at the greatest circumference, and of course the portion of the revolving sphere that offered the least resistance (the poles) succumbed to the demands of the internal shrinkage and were drawn inward; and so we find the earth slightly concave at the poles.

The cooling of the metal in a mold, while not exactly similar, is strikingly analogous to the cooling of a planet or the earth on which we live.

Matter is never at rest; the atoms comprising the molecules revolving around a common center, forming a miniature solar system, are in a constant state of agitation, moving rapidly around in their medium of ether, and confined in their movement to the limited space between them and their fellows.

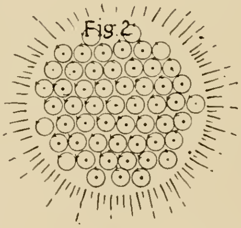
Now the outer surface of a mass of matter is the first to be susceptible to any thermal change, the effect being transmitted toward the center; and if this thermal change be of a sufficiently high degree to change the state of the mass from the solid to the liquid, or gaseous, or *vice versa*, the surface is the first to exhibit these manifestations. (*Fig. 1*).

Fig. 1



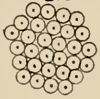
Let us suppose *Fig. 1* to represent a cross section of gold plate, magnified to such an extent that the molecules are visible, and represented by the small circles or spheres. Now, should this plate be subjected to a heat of a sufficient degree, the atoms of the molecules revolve more rapidly than before, become more divergent in their tendency, describing a larger circumference about their common center. The molecules increase in the same proportionate volume, and their mutual power of cohesion diminishes, and this allows the molecules to separate more widely, and permits of a greater latitude in which to exercise their mobility. As the atoms are whirling about their common center the molecules are revolving, and revolving also about each other, generating centrifugal force to such an extent as to overcome the force of gravity, and with a tendency towards projection in every direction; held in restraint only by the still active but greatly diminished power of cohesion. This causes some molecules to be lifted above their fellows and as heat increases the mass begins to assume a globular form (*Fig. 2*), and presents a panorama of rhythmic harmonious action.

Fig. 2



Now, if the heat be withdrawn the revolutions of the atoms about their common centers decrease, and as their momentum gradually diminishes, the atoms come into closer proximity, the molecules decrease in volume, the power of cohesion increases, the mutual attraction of the molecules becomes more intense, exhibiting more influence than the force of gravitation, and the congealing mass of metal retains more or less of the globular form; the molecules being caught in the act of falling much the same as water is caught and held in the formation of an icicle. (*Fig. 3.*)

Fig. 3



The duration of time in which the metal is transformed from a molten to a solid state is exceedingly short, and the fact that the metal retains enough heat to maintain a red color for a time, furnishes no scientific proof that the metal in the mold will shrink, for the metal that remains in the crucible and the metal in the mold encounter conditions in hardening that are diametrically opposed. The metal in the crucible is confined by no walls, and the pressure on it being from without inward has no such effect as on that confined in a mold, for the reason that the hydraulic pressure that the confined gold is subjected to forces the metal from the center outwardly as long as it remains molten, and thus it is pressed against the cooler walls where the crust as described is formed, and which will register a density of 19.45, against 19.16 of that remaining in the crucible, and there is no inherent force or physical property in the metal itself after being cast under pressure capable of augmenting its density to any further degree; so it is physically impossible for it to shrink. Therefore, if in the process of making an inlay or a more extended piece by casting under pressure any distortion occurs, or if it is not a fac-simile of the wax model, the discrepancy must be ascribed to some other factor or cause than the shrinking of the gold.

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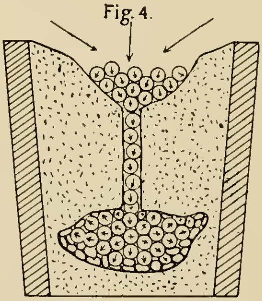
If this globule of gold were measured for its specific gravity it would be found that it developed, by the mutual attraction of its molecules (cohesion) a density that registers a relative specific gravity of 19.16. Thus, if gold, heated so as to assume the liquid state, be allowed to congeal uninfluenced by any interfering conditions, the only factors entering into the phenomena being mass, cohesion, heat, molecular mobility, volume and gravitation, it is a physical impossibility for the metal to develop, by virtue of its cohesive force, a density that registers a relative specific gravity above 19.16. In the casting of metal under pressure, additional factors enter, and must be taken into consideration; they are hydraulic pressure and welding, the latter being induced by the force of hydraulic pressure.

If a mold has been prepared in the usual procedure for a cast under pressure, and is in a condition for the reception of the molten metal, a button of gold fused in the crucible manifests the same physical phenomena previously described and represented by *Fig. 2.* The atoms will revolve around their common center more rapidly than at a lower temperature, and the molecules will revolve around each other in like manner and the metal is gradually transformed from the solid to the molten or liquid state. If force now be suddenly applied to the liquid mass in the crucible a portion of it will be forced by displacement into the mold, and if the pressure be maintained for a time it will be transmitted from molecule to molecule simultaneously in every conceivable direction, the hydraulic force pressing the molecules to all surfaces and angles of the mold. As the molecules at the surface of the mass come in sudden contact with the walls of the mold, their movements are abruptly checked, the atoms of the molecules are forced to closer proximity, the molecules decrease in volume and have less latitude in which to exercise their mobility, which instantly induces congelation; and as they are held firmly against the walls of the mold, gaps and crevices occur, which are, however, filled by the pressure behind, and with inconceivable rapidity, with new recruits, frenzied and heat-maddened, where they meet the same fate as their fellows, crushed and jammed against each other and the walls of the mold until in congealing a rigid wall or capsule lines every surface and angle of the mold. (*Fig. 4.*)

Fig. 4.



This goes on in the same way until the surface crust thickens to the center, all following the same regular order of things, but with no loss of appreciable time, in a small mass of gold as might be inferred from the deliberate description. This metal will be found to be of higher specific gravity than when it is allowed to cool under ordinary conditions. A pressure of 12 pounds induced by expanding gas will bring about a density or specific gravity of 19.45.

TELESCOPIC CROWN FOR BRIDGE WORK

BY E. L. KANAGA, D.D.S., PHILADELPHIA, PA.

No. 1 A piece of metal for the band is cut from 30-gauge coin gold, the occlusal end being 1-32 of an inch smaller than the gingival.

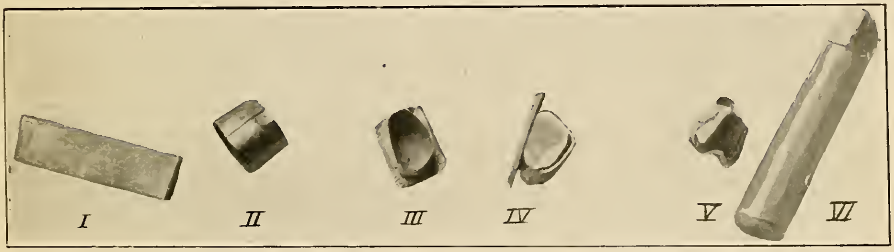
No. 2. Showing the band joined, sweated.

No. 3. The floor sweated to the band.

No. 4. The core is formed by holding the inner cap in a paper form and pouring fusible metal into it.

No. 5. The outer cap is made by driving the inner cap, now mounted on the core, into it.

No. 6. Shows method of obtaining contour.



TO HOLD AN INLAY WHILE CEMENTING

You are setting an inlay in the back of the mouth. You need a handle on the inlay; you cannot pick it up with your fingers to place it; it may snap out of your pliers. Put just a drop of hard wax on the inlay. Now warm a square-end burnisher or amalgam plugger, place the point in the wax; instantly it is hard and you have the inlay so you can place it correctly after the cavity is smeared with cement, and an instrument with which you can force it to place quickly, thus enabling you to use a thicker mix.

THE EXTENT TO WHICH THE CASTING PROCESS MAY BE ADVANTAGEOUSLY APPLIED TO CROWN AND BRIDGE WORK

BY HART J. GOSLEE, B.S., D.D.S., CHICAGO

While it may be true that the proportion of those who ever attain to the very highest achievements in any mechanical pursuit is not a large one, still I am of the very firm belief that the casting process has afforded an opportunity for raising the standard, and increasing the percentage of uniformly good results; and, in the light of our present achievements, that this standard will become higher and higher in proportion as we recognize our own personal limitations, and realize the full scope of its possibilities.

Those who, by a process of self-analysis, may thus recognize their own limitations, will not expect a mechanical process, or a machine of any make or kind, to adjust and adapt itself to the varying and intricate demands of an exacting line of work, unless the process is followed, or the machine operated, with an average degree of human intelligence; and those who fail to recognize this are surely destined to meet with failure.

Thus it is more than probable that many may have failed in attaining to the heights of even average success simply because they expected too much of the process involved, and exacted too little of themselves: but those in this class never become enthusiasts, and those who never become enthusiasts rarely become experts in any line.

When the average operator realizes these essentials to success, then the average operator may reasonably hope to rise above the average and achieve success in the application of the casting process, and as he appreciates them will he also find the field of usefulness broaden and the possibilities become more and more unlimited.

While this is undoubtedly true, to a greater or less extent, as applied to the whole field of dental prosthesis, it is particularly true as applied especially to the subject which it is my purpose to discuss at this time—that of crown and bridge work.

For many years patients wearing crown or bridge work, however limited or extensive in character, were involuntary advertising mediums for dental jewelers; were forced to display shocking evidences of a handicraft which, while in some instances useful, perhaps, was usually far short of art, and always more or less repulsive.

These evidences, I am sorry to say, may still be observed, but fortunately not to the same extent. As a profession, we are beginning to strive for higher ideals in the art side of our work, and in this respect we are aided materially by the demands of an ever-increasing degree of culture on the part of our patients.

Since porcelain has always been and is still the one substance which most closely simulates nature, and therefore best meets the requirements, this fact, together with these combined ambitions on the one part, and demands on the other, must lead one to conclude that more porcelain and less gold must be used in an effort to satisfy each.

Such manifestly desirable advantages are now to be obtained by means of a skillful application of the casting process, combined with a more general use of all-porcelain teeth instead of the ordinary thin facings.

You will probably agree with me that this type of tooth is preferable for single artificial crowns, because it affords better form, better color and greater strength than it is possible to obtain from the use of facings. Also that an all-porcelain tooth is better for bridge work because the presence of an occlusal surface of porcelain instead of gold, on any or all of the posterior teeth, is advantageous not only for cosmetic and hygienic reasons but for actual masticatory purposes as well.

These advantages are so evident that the more esthetic operator has been forced to look and hope for some form of tooth, and some method of application which would eliminate the inherent weakness of thin facings, and the objectionable features incident to their use.

To overcome the shortcomings of the so-called "Richmond" crown, and of the ordinary bicuspid and molar dummy with porcelain facing and gold cusps, the advantages of some form of interchangeable or replaceable all-porcelain tooth, more closely simulating the form and color of the natural teeth, were early recognized. As a result of this recognition, many types have been introduced, but until very recently most of them have been of the thin facing variety, and applicable to the anterior teeth only.

While the all-porcelain teeth, such as the Davis, Logan and Justi crowns, have always been recognized as being the nearest approach to an ideal substitute for the natural teeth, yet they were not originally designed to meet the present requirements of crown and bridge work, and hence their use has been confined to that class of cases where more or less temporary results were all that was expected or demanded.

If the esthetic and hygienic advantages possessed by this type of tooth, however, could be combined with those of exact adaptation, and uniform and adequate strength, and if to these might be added the further advantages of being cemented to the structure instead of soldered, and of being replaceable and more or less interchangeable, it is evident that our efforts would be a nearer approach to the ideal.

In my opinion, which has been often expressed, the attachment of porcelain teeth or even facings to the metal structure by means of soldering, or of direct casting, is wrong. It is a wrong principle because the porcelain is subjected to a degree of heat which must endanger its structural integrity and influence the preservation of its color; because the tooth or facings is thus attached in a stiff and rigid manner, and, being friable, is more likely to fracture under the stress of mastication; and because, in the event of accident, no favorable opportunity for repair or replacement is usually afforded.

I think you will also agree with me, therefore, that the elimination of these objectionable features must necessarily constitute an improvement, and that such an improvement is to be obtained by the use of replaceable teeth attached to the supporting metal structure only by means of cementation.

An experience of many years has proven that this means of attachment is reliable in proportion as the adaptation of the metal to the porcelain may be close and accurate, or, in other words, in proportion as the porcelain may be "boxed up," protected and supported. It is stronger when so attached because it is not subjected to any degree of heat, and is not held so rigidly, due to the cushion-like effect afforded by cement; and because, not being held so rigidly, it is less likely to become fractured. Furthermore, the color is never changed; those dark blue marginal outlines due to the penetration of saliva between backing and facing are absent, and opportunity and facility for replacement in the event of accident always presents.

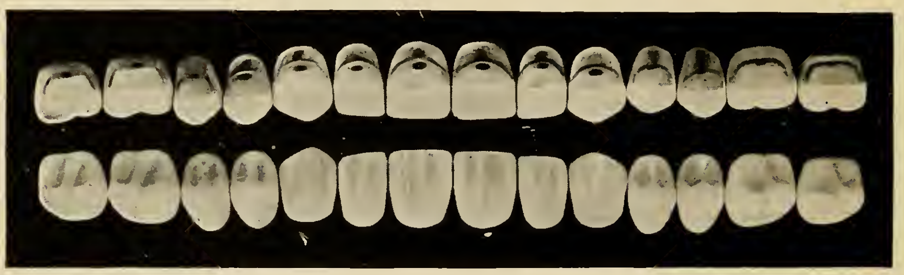


Fig. 1

As I have previously stated, these possibilities and advtantages are to be adequately obtained only in some form or type of tooth which presents as much porcelain as possible, which porcelain is not weakened by the presence of metal pins nor by the provisions for retention, and which, therefore, possesses a maximum of strength; which is of natural form, more or less universally applicable, and which will need but a minimum of grinding for effecting the desired and required adaptation.

This latter feature, as applied to the retentive surface, is essential, because in proportion as a given form of porcelain tooth will require but little or no grinding upon this surface in effecting its adaptation to the requirements of the individual case, may it be expected to be replaceable or interchangeable.

These combined advantages, I believe, are to be obtained in a form of tooth suggested by your essayist, and now known as the "Goslee Interchangeable Crown and Bridge Tooth," (*Fig. 1*) to which I am pleased to call your attention.

It will be observed that these teeth as now made are of natural form; that they possess the splendid strength and color characteristic of the Consolidated tooth bodies; that they are adapted to single crown work where any form of metal base is used, as well as to intermediate teeth, or "dummies" for bridge work; that they afford a minimum display of gold and require but a minimum amount of grinding, and that with a sufficiently large variety of molds they should be almost universally applicable; also, that they are strongest where the greatest strength is required; and that they offer ample opportunity for secure retention to the supporting base or structure.

A further advantage made possible by the use of replaceable or interchangeable teeth, which applies particularly to especially difficult cases, is to be obtained by making duplicates; and while it is true that any form of interchangeable tooth is far less likely to become broken from the stress of mastication, yet the making of duplicates coincidentally with the initial construction requires but little time, is always a source of inestimable protection to the particular patient, and affords unlimited relief and satisfaction to the dentist. It is, therefore, a safeguard which might be observed often and profitably by everyone whose necessarily small fees do not render it prohibitive.

In all instances, however, whether duplicates are made or not, the color number and mold number of each tooth used in every case should be recorded on the card or ledger sheet, and thus made a permanent part of the record. Because of these advantages and for these various reasons I firmly believe that only some form of interchangeable tooth should ever be used in single crowns, or "fixed" bridge work, of any type, if the best results and highest possibilities are to be attained in our efforts.

In addition to such desirable improvements as may be achieved by the use of teeth of this character, the introduction and application of the casting process has placed this field of our effort upon a more systematic and practical basis, as an evidence of which permit me to call your attention to the methods which I am now generally employing, almost to the complete exclusion of all other and former procedures.

SINGLE CROWNS

For the ten or twelve anterior teeth, or all teeth within the range of vision, where porcelain is demanded, the all-porcelain replaceable or interchangeable crown, with *cast base,* and with or without a band, as the requirements may indicate, is used in a very large percentage of cases. It is undoubtedly the strongest, most artistic, and most universally applicable type of substitute for the natural tooth, and in all respects is second only to a skilfully adapted "jacket" crown. Indeed, for the average dentist it is better, more quickly and easily made, and, moreover, it possesses an advantage over the latter in that immediate replacement, in the event of a mishap, is possible.

PORCELAIN CROWNS WITH CAST BASE

In the construction of this type of crown much difficulty has heretofore been encountered in molding the wax to a close adaptation to both the root-end, particularly at the periphery, and the base of the crown, and in holding the dowel or dowels in the proper position to insure correct alignment.

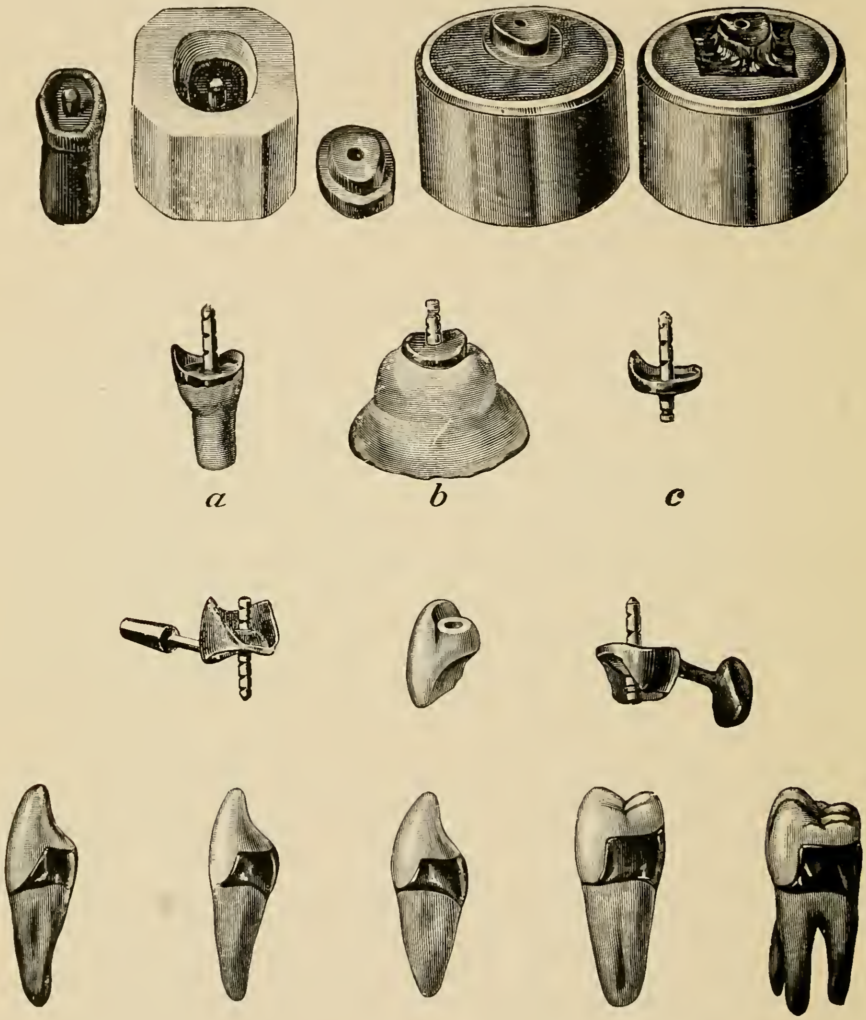


Fig. 2

These essential features have usually been so uncertain, and in some instances so difficult and so unsatisfactory, as to cause me to work out and suggest a technic which eliminates such uncertainty, which insures accuracy, which is applicable alike to all cases, whether a band is required or not, which relieves the patient of any discomfiture whatever, and which has proven the most satisfactory method of crown construction I have ever followed.

In the various methods now generally used and advocated, good, accurate, reliable results are difficult to obtain, because the very plasticity of wax of any kind makes it possess a tendency to spread when subjected to the pressure necessary to mold it to a close adaptation. This tendency is best and most easily overcome by first adapting 38 gauge pure gold to the root-end, which may be done either by swaging or burnishing, and then adjusting the dowel, tacking it to the base with solder, and subsequently molding the wax to both base and tooth and casting directly to this disc of pure gold. If carefully done, the surface thus obtained will always be a closer fit to the root-end than can be obtained from the molding of wax alone with any investment material now procurable, and will require no finishing whatever after casting.

Such a procedure also reduces to a minimum the possibility of any change of form which may result from the warpage or shinkage of the gold or alloy used in casting, but to obtain the best results necessarily involves the impression and die method, as illustrated in *Fig. 2*, and explained in detail in the *Dental Cosmos,* August, 1911.

The entire process requires but little time, is simple, insures a more or less perfectly adapted base, and one which is obtained without the slightest discomfiture to the patient, which is not possible when *burnishing* directly to the root-end is attempted. For single crowns a slight lingual lip or band is usually all that will be required. This strengthens the attachment between crown and root, and precludes the possibility of subsequent fracture of the root—for which purposes a band is usually used, but in all cases where the crown is to be used as a bridge abutment a full band should remain.

The construction of a crown by this method usually involves but three short sittings, and the best results are to be obtained by doing all the work directly in the mouth. At the first sitting the root is prepared, the root impression taken, the mold number and color selected, and a temporary crown mounted. This latter feature is desirable as a means of packing the soft tissues away to afford and insure a free exposure of the root-end at the next sitting, as well as to relieve the patient of the temporary embarrassment. The amalgam die having been made and the pure gold disc swaged and tooth selected, in the meantime, at the second sitting the cap is fitted to the root, the dowel and tooth adjusted to the requirements, the dowel then soldered to the cap, and the relation between the tooth and cap secured with casting wax. The crown is then cast, the tooth cemented to place and finished, and the final mounting is made at the third sitting.

GOLD CROWNS

For second and third molars—and even first molars, when the presence of gold is not objectionable—the cast gold crown affords results far in advance of anything heretofore obtained. In the construction of gold crowns by the casting process, however, the fit or peripheral adaptation is, because of the spreading tendency of the wax, *always best obtained* by previously fitting some form of band to the root and then casting directly to it.

Technic: Whenever it is desirable to exaggerate the contour, a narrow band of platinum or 22-karat gold, of about 30 or 32 gauge, should first be made to fit snugly around the entire periphery and then trimmed to evenly approximate the end of the root, after which all of the contouring may be done in wax, which can be best done, perhaps, on a model.

When an exaggerated contour is not required, however, and one seldom is, the band may be made of 28 gauge, 22-karat gold, and fitted and contoured in the usual manner. When in position on the root, casting wax is then molded to the end of the root inside of the band, and this procedure followed by an imprint in the wax of the opposing teeth in all the movements of mastication.

After the band has been removed, its interior should be filled at once with casting investment material and the occlusal surface properly carved, after which it may be invested and cast, using for the casting the same grade of gold of which the band was made. (*Fig. 3.*) If the band is thoroughly clean before investing, and the gold to be cast is of good quality and highly fused before casting, a good physical union will usually result; but if it does not, a small bit of 22-karat solder will insure the same.

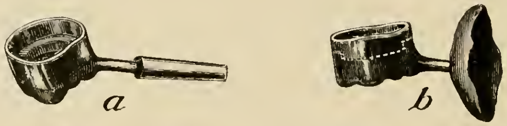


Fig. 3

These two general types of crowns will meet the requirements of single crown work in a very large majority of cases, and the results by either method are far more accurate than by any of our former methods.

FIXED BRIDGE WORK

In fixed bridge work, which constitutes an assemblage of attachments and intermediate dummies, our work may also be simplified, because three general types of attachments and three general types of dummies will be found to meet the requirements in an exceedingly large percentage of cases.

Attachments: The methods of obtaining attachment to the supporting teeth or roots embrace the procelain replaceable crown with dowel and cast base, the construction of which has just been referred to, as applied to the roots of anterior teeth, or when it is impossible or inadvisable to preserve the natural crown; the inlay, when the attachment is to be made to the crown of a natural tooth, which is good practice when the remaining natural crown is sufficiently strong, and the gold crown for the molar teeth when the use of an inlay is for any reason not indicated.

As previously emphasized, wherever a dowel crown is to serve as an attachment for bridge work, a narrow band should always be used. In my opinion, this is absolutely essential, because of the additional strain to which the root is to be subjected, and as a means of insuring permanency and precluding fracture.

When an inlay is to serve as an attachment the cavity preparation is, of course, exceedingly important, and some form of post or posts should always be used to insure stability and as a provision against the inlay becoming loosened by the strain and possible torsion to which it is to be subjected.

The general applicability of the inlay as an attachment for bridge work has been a subject of considerable discussion ever since casting became an accepted practice. That it will serve the purpose as well as, and in some respects even better than, a full crown there can be no doubt, providing its adaptation and stability are insured.

The former depends first, upon adequate and proper cavity preparation, and then careful technic in making the inlay; and the latter depends upon the use of a proper alloy in casting, and upon pins or posts of some form, for the reasons mentioned.

Wherever the walls of the supporting tooth are sufficiently strong to insure permanency. whenever a suitable cavity may be properly prepared, the inlay, well-seated and securely anchored, and made of a hard alloy, such as five per cent. platinum in pure gold, coin gold, or 22-karat gold, I am of the impression that such an attachment is often better than a full crown because of the absence of any possibility of gingival irritation, such as is so often present where the latter is used.

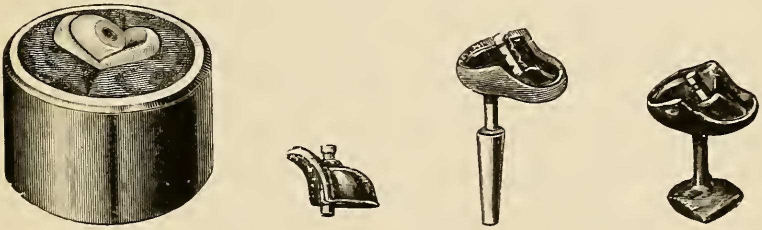


Fig. 4

The cavity preparation for such inlays does not differ essentially from that for a simple filling, excepting that its buccal, lingual and cervical margins must be so extended as to carry the margin between tooth and filling beyond any actual contact of the artificial tooth to be supported by it, in order that each and all of these margins may be exposed, for hygienic reasons. (*Fig. 6.*)

"Dummies": As dummies for fixed bridge work, three general types will answer the requirements in all cases.

The all-porcelain replaceable crown and bridge tooth with cast backing is adapted to all positions in the arch where the conditions of absorption and occlusion will permit their use, and is undoubtedly the ideal form of artificial substitute. Backings for these teeth should usually be cast separately, though they may be made in sections involving the number of dummies between the attachments, which should never exceed three, or possibly four. Better form, cleaner interproximal spaces, and less display of gold, however, are obtained by making each backing separately.

As a means of preserving the proper relation of the short sustaining post which holds the tooth to the backing, and of insuring a smoother surface adaptation of the backing to the porcelain than the ordinary casting investment materials afford, in using this type of "dummy" a thin backing of about 38 gauge, pure gold should be previously swaged to the tooth, as indicated in *Fig. 4*, and the post soldered to it. It is then always necessary to allow as much surplus end of post as possible to extend beyond, in order to insure strength in the final attachment of this essential part to the completed backing.

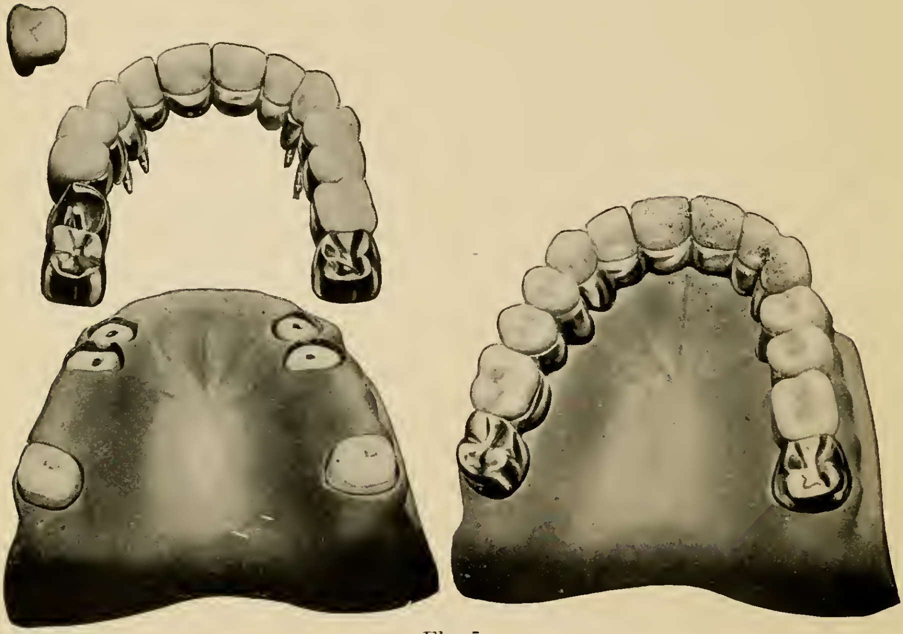


Fig. 5

Casting wax may then be molded to the required form, and the casting made directly upon and against the thin gold backing, by which method any distortion or possible misfit due to thrinkage or warpage is overcome, and the most finished, accurate, and reliable results are insured.

In the use of this type of tooth in all cases in the upper arch where complete absorption has already taken place, the most sanitary form of structure is usually to be obtained by molding the wax so as to restore or approximately follow the lingual form of the tooth, but tapering down to a narrow saddle at the point of contact with the soft tissue. As a rule, and contrary to the opinions of some, however, wherever the adaptation is good, such a type of construction will be found to be far more sanitary than the usual recesses, shelves, and pockets, so common in the ordinary methods.

In the formation of this type of saddle, the desired results may be best obtained by first burnishing the same thickness of pure gold to the model, between the finished abutments in position thereon, and then trimming it to conform to the size of the necks of the teeth to be supported by it. The general form of the structure may then be made by filling in between this saddle and the backings with wax, after which the piece may be invested and cast. Or in instances where this space is exceedingly small it may be filled with solder.

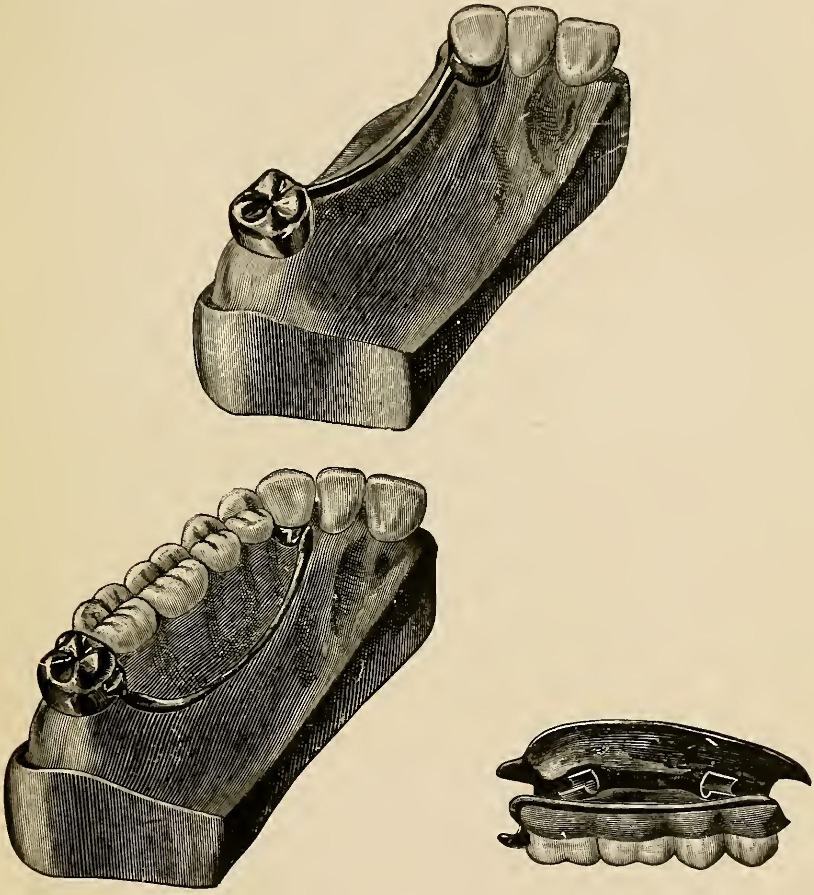


Fig. 6-A

In this more or less typical fixture (*Fig.* 5), it will be observed that practically no gold is displayed anterior to the second molar, and yet

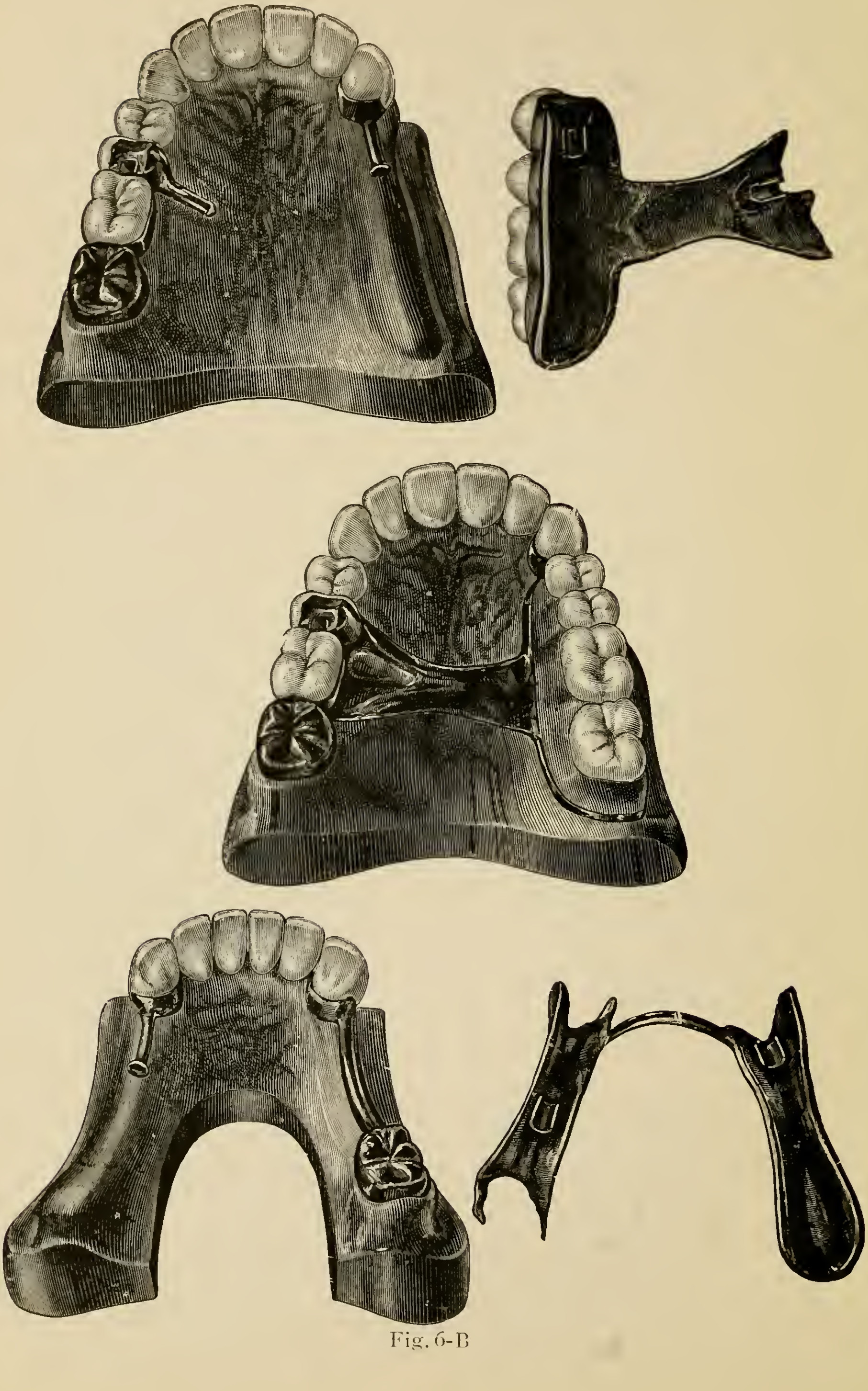


Fig. 6-B

that a maximum of strength presents throughout.

In cases where complete absorption has not occurred, a saddle is, of course, contraindicated, but in these cases the neck of the porcelain tooth should accurately fit and should bear firmly upon the soft tissue, and the lingual surface of the backing should then be so formed as to be as nearly convex or self-cleansing as possible.

For those cases in the anterior region where abnormalities of occlusion or elongation of the opposing natural teeth demand a thin facing, the ordinary type of long pin facing may be used. In its use, however, the best results are to be obtained by previously backing it up with thin pure gold, adding wax to this to the desired form, removing the facing and casting. The pins may then be threaded and, when the backings have been assembled with solder, the facings may be cemented to position, thus obtaining all of the previously mentioned advantages of cementation, combined with better form and more uniform strength.

In addition to these, for those cases particularly in the lower arch, and in exceedingly "close-bites," where cosmetics is not a factor, or where the extent of absorption or the elongation of opposing teeth precludes the use of porcelain in any form, the all-gold, cast dummy may be used. Such dummies may be made to conform to the requirements of occlusion, adaptation to gum—if such is required—and contact with the attachments, in wax, and then invested and cast in one piece. This type of "dummy" is useful in supplying the lower second bicuspids and first and second molars and may include only the occlusal surface, thus forming the so-called "self-cleansing" type of bridge, or the entire tooth with or without a saddle, as the requirements may be. The former type of construction is indicated only where there is an excessive degree of absorption, which will permit of sufficient space between the gum and occlusal surface to insure self-cleansing properties, and wherever this space is not great enough to be *easily kept clean,* direct contact with the gum will afford a more hygienic result. In other words, there should be plenty of space, or none at all. A typical case of this kind showing the use of all-porcelain dummies in connection with inlays is illustrated in another model.

With these, the problem of attachments and of intermediate dummies for almost universal application is simplified and systematized.

The remaining feature incident to the construction of all forms of fixed bridge work involves only the proper assemblage of the various parts. While some are casting all attachments and backings with an alloy of five per cent. of platinum in pure gold, and subsequently assembling them with pure gold, thus using no solder whatever, still a good grade of 22-karat gold or coin gold may be used with equally good results. When either of the latter is used, the final assemblage may be effected with 22-karat solder, and providing there is absolute contact between all of the parts to be united, the procedure is thus somewhat facilitated, and the results are uniformly good.

REMOVABLE BRIDGE WORK

The same general ideas are also applicable to the construction of removable fixtures.

For this class of work, also, three general types of anchorage to the supporting teeth or roots will be found to adequately meet the requirements of the average case. These embrace clasps, the telescoping tube and split post, and the various forms of manufactured attachments.

Wide clasps encompassing three angles of the tooth, provided with an occlusal rest, not cast, but made of heavy rolled clasp-metal alloy, probably afford the very best means of obtaining anchorage to the natural or artificial crowns of biscupids and molars.

That clasps should not be cast is especially emphasized, because the molecular rearrangement resulting from casting most of our present alloys destroys to a greater or less extent the very qualities of strength and resilience demanded of them, and which undoubtedly obtain best in a rolled or drawn metal or alloy.

In all forms of removable bridge work or partial dentures, where clasps are used, however, some form of occlusal rest is necessary as a means of providing against subsequent settlement of the case. If this precaution is not observed, complete loss of occlusion and usefulness will soon follow.

The telescoping tube and split-post attachment is also useful when confined to the roots of the six anterior teeth.

The Roach, Morgan, Gilmore and other types of manufactured attachments will also be found valuable when used in connection with either porcelain or gold crowns or inlays on the cuspids and bicuspids.

When the type or types of attachment thought to be best indicated have been selected, adapted, and completed, the casting process then offers splendid opportunity and great possibilities for the subsequent formation of the body of the fixture, and in this connection I believe that the successful casting of large pieces is only a question of the development of proper technic.

In the construction of cast bases, if a good model of a high-grade investment material is obtained, and if the wax base is carefully formed, made sufficiently thin and properly stiffened, the process offers the same assurance of accuracy of adaptation and of strength as previously indicated, and the possibilities are equally unlimited. For all forms and sizes of saddles, or bases, coin gold seems to be especially adapated to cast work, and to afford all of the integral strength ordinarily demanded.

In the presentation of much of this technic, quotations from former papers have been necessary, to a greater or less extent, but the fact that repetition is made to serve in preference to changes and alterations only proves that I am still courageous in my previous convictions.

As a final suggestion, permit me to again impress upon you the advantages of simplifying and systematizing your methods, and of casting; the necessity for careful technic and the unlimited possibilities resulting therefrom.

CAVITY PREPARATION FOR CAST GOLD INLAYS

BY THOMAS P. HINMAN, D.D.S., ATLANTA, GA.

In reading the literature on the subject of cavity preparation for cast gold inlays, I find that very little attention seems to have been paid to this most important subject. Operators who had been constructing gold inlays by the gold or platinum matrix method previous to the announcement of the Taggart inlay have evidently been using practically the same method of cavity preparation for the Taggart inlay as they have been accustomed to when using the gold or platinum matrix. In making this statement I am judging the mass of our profession by those with whom I have had discussions along this line.

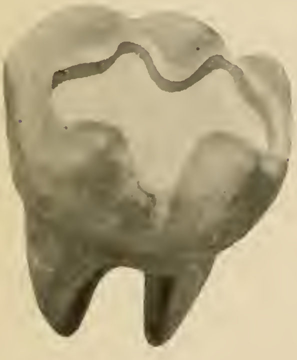


Fig. 1

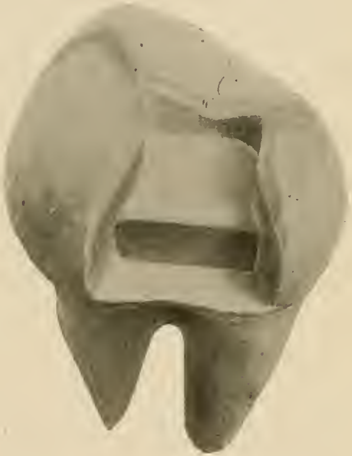


Fig. 2

In using the metal matrix all that was necessary to avoid in cavity preparation was undercuts, for it is obvious that if the matrix could be removed from the cavity without distortion, it could be filled with solder and returned to the cavity and would seat as perfectly as before. This, however, I have found, is not true of the inlay cast from a wax impression. The reason for this is that if the sharp angles are left in the cavity they are reproduced in the mold or investment, and when the molten metal flows over them it rubs the investment in such a manner as to round these sharp corners, and when the inlay is returned to the cavity it will not properly seat.

I have found that inlays cast for cavities in the proximo-occlusal surfaces of the bicuspid when prepared by the old method will lack to a considerable degree seating at the gingival border. This observation has been made by numerous other operators and has been accounted for to a considerable extent by the theory that gold shrinks on cooling, but my observation has been that the shrinkage of the gold will not entirely account for the misfit of the inlay. Again, the floor of the cavity has been left rough and the inlay will not seat because these same indentations are not perfectly reproduced in the casting, as the very sharp edges are rubbed off by the molten gold as it flows into the mold.

Fig. 1 represents a cavity in the occlusal surface of a lower molar. You will note that all of the angles have been removed from the cavity margins and axial walls and that the floor is perfectly smooth and flat. Note also that the margins are very slightly beveled from within outward, so as to allow a narrow lap of the gold at this point, preventing the pumping out of the cement during mastication. If the cavity was left with sharp angles where the fissures cross and an inlay cast for the cavity, it would not seat or fit, because the sharp angles in the investment would not be reproduced in the inlay for reasons heretofore stated. This would not be true if we had an investment sufficiently hard to withstand the friction of the molten metal.

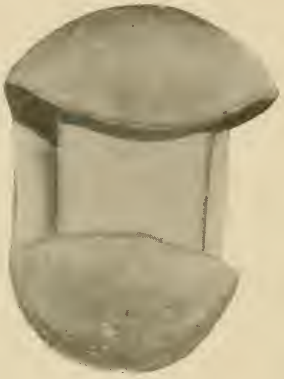


Fig. 3

Fig. 2 represents a cavity in the mesio-occlusal surfaces of the bicuspid. Note that the neck of the retention step has no sharp angles to be knocked off by the molten metal flowing into the mold. Note also that where the step joins the axial wall that the sharp angles have been rounded with a stone. If we use curves instead of angles at these points the inlays cast to fit such cavities will seat perfectly.

Fig. 3 represents a compound cavity in a bicuspid correctly prepared. Note the sweeping curves and the absence of acute angles.

IN GENERAL

If cavities are prepared with small carborundum stones instead of burs, there is less liability of producing angles and rough floors, and inlays cast to fit cavities thus prepared have smoother surfaces on the side next the dentin.

THE CEMENT LINE IN INLAYS

BY CLARENCE J. GRIEVES, D.D.S., BALTIMORE, MD.

NOTE—The writer respectfully refers all interested, to his paper, "Cemented Inlays or Contact Fillings, Which?" read before the Virginia Dental Society, August, 1906, and published in *The Dental Summary* which deals with work on the first phase of this subject, and is necessary to an understanding of his position in this article.

The one leading question foremost in the mind of every operator who attempts restoration of destroyed dental tissues, second only to the removal of the destroying agents and the destroyed and the shaping of caval edges, is whether the final cavo-juncture between filling and enamel will be lasting mechanically to meet stress, and to prevent retention centers for recurrent caries and adhesive chemically to prevent leakage by solution, by sealing these edges. So obvious is the importance of the subject, for it is the final equation in the art of operative dentistry, that this paper needs no further introduction. No matter what the method or filling material heretofore employed, its perfect adaptation required cavo-surface contact excluding mouth juices; edge strength to meet occlusal food impact, supporting caval enamel edges; smooth surfaces to prevent re-attachment of gelatinous carious plaques; extension out into the embrasures to prevent the retention of food and be cleansed by the brush of it in mastication, practiced with varying results dependent on the material, location of cavity, skill of the operator, immunity of the patient, etc., etc., we find all of these time-honored requirements for a successful contact operation completely reversed by the advent of the method of the cemented inlay filling.

During the inlay period, of say, the past fifteen years—long enough in all reason to test a new principle—we note a paradox of both man and method; the same operator who formerly spent hours in attempting these perfect adaptations of gold foil to caval walls is now willing to leave them, to a degree at least, marginally open to the wash of the saliva; proximally, in the same mouth environment, we daily see porcelain inlays with cemented joints washed out exposing enamel margins, through which the light rays pass into the porcelain, in this way only matching the tooth surfaces which they restore, lying directly adjacent to gold foil operations in perfect contact with similar enamel caval margins. Both operations apparently saving tooth structure, yet based and built upon principles diametrically opposed, can both of these methods be right? Are the countless daily converts to the cemented inlay wrong in thus forsaking axioms sanctioned by long experience? The answer to these and many other associated question is, we believe, to be found in a study of how mechanically-made contact on the one hand and chemically-made adhesive cemented contact on the other will meet and overcome the bite stress and carious environs of the human mouth. As soon as we depart from the teachings of the forefathers, absolute marginal contact of filling material and cavity edges, we find the greatest divergence in principle and method amongst the inlay "cult" in caring for these edges; for while all inlay operators insist on an adhesive cementing media between filling and tooth, they sharply divide on the final cavo-surface finish of the filling into:

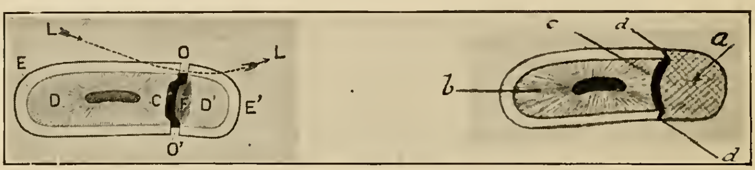


Fig. 1 Fig. 2

Fig. 1—From Nyman's "Porcelain Problems," *Cosmos*, 1905, diagrammatic section showing how washout at "o" in butt-joint porcelain fillings affect color; "e" and "d" section of tooth; e' and d' filling. Note the necessary washout at o'-o of cement c that filling may match.

Fig. 2—Application of the same diagram by writer to gold inlay lap-joint; "a" gold inlay; "b" section of tooth; "d" lap-joint from which there is little loss of cement "c."

"A," *Fig. 1. Butt-joint operations*, necessary from the friability of the material *in all procelain fillings, where the cementing media is expected to wash out the depth of the width of the joint*,[12] that the filling may reflect light and match; the cavo-surface angle is at right angles, or 90 degrees, as is the filling surface angle; the joint is open to the pump of foods in bite stress when exposed, and to cement solution from mouth fluids. With the finest technic these joints in porcelain inlays can be made only as fine as the thickness of the matrix foil after burnishing. Head[1] says such joints are from 1½ to 2½ times the thickness of the foil used (.0001 of an inch); at the best, they are as open as the size of the cement powder granules; this is necessarily limited because extremely fine powder makes cement set so rapidly as to be impractical. Poundstone[2] found only five out of all the cements studied with powder granules, after solution in mixing, fine enough to permit a joint .0001 of an inch under 25 pounds' pressure. The *butt-joint* in gold inlays is subject to all of the doubtful variations produced by contraction of wax and metal and expansion of investing material; if the inlay exactly fits the cavity it will protrude by the distance of the largest cement powder granules which have not gone down in the mix.

"B," *Fig. 2, Lap-joint operations*, possible always from the ductility of the material, gold and its alloys, *in all gold inlays, where the*

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[12] Nyman, J. E.—Porcelain Problems.—*Dental Cosmos*, 1905.

[1] Head, J.—Test of the Inlay Cement Problem.—*Dental Cosmos*, 1905.

[2] Poundstone, G. C.—Discussion of the Cement Problem in Inlay Work. Proceedings, Fourth International Congress.

marginal cementing media is not expected to wash out for appearances; the cavo-surface angle is anywhere from a little less than 90° to 40°, often topping enamel rods as in best foil operations; the marginal cement is protected from the pump and lave of bite stress and to a degree from the mouth fluids by burnishing down the lap to the enamel rods, thus taking up any protrusion made by cement granules in the cement line *which does not face* the impact of foods, as in *butt-joints*, but rather *faces directly away from it*, a great advantage.

These two great classes must be subdivided again into:

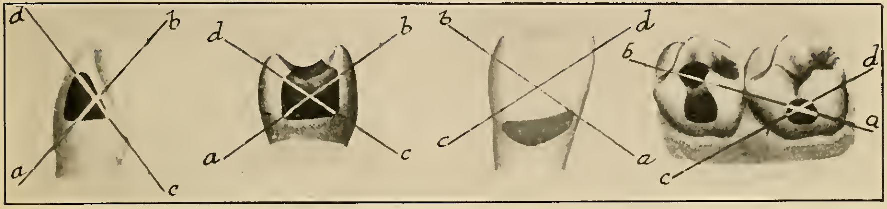

Fig. 3—Cuts of filling from Black's "Operative Dentistry." Intersecting lines made by the writer.

First: Those which on section show the cementing media throughout the filling as only a line on the pulpal and axial walls, the filling seated mechanically in the cavity.

Second: Those which on section show the cementing media as a line only at the margins, appearing in bulk throughout the filling to ofttimes as much as one-third on the pulpal end axial walls; the filling may have some mechanical retention, but more is expected of the cement "en masse" as a retainer.

All of these classifications are absolutely necessary, because of the vast difference in behavior of the cement line as between butt and lap-joints in all mouths; further, it was found early in these observations, which were undertaken some years ago and have been followed up both in and out of the mouth, particularly with honed sections, that while cavities and inlays made by any method were subject as all operations should be to the rules laid down by Black,[3] there were certain exceptions to these rules, particularly in butt-joints, in the areas of possible damage which are diagrammatically here shown, and may be known as the *vulnerable inlay areas*, defined as follows:

Dividing the proximal surfaces, *Fig. 3*, of the incisors and canines by a right line, "a-b," which arises just at the gingivus in the labio-gingival angle and cuts the surface, emerging on the lingual surface midway between incisal and gingival; by a second right line, "c-d," which arises at the gingivus in the linguo-gingival angle, cuts the surface, emerging on the labial surface, one-third of the distance from the incisal to gingival; the proximal surface is thus divided into unequal triangles which may be termed the labial, lingual, incisal and gingival triangles, the smallest of which is the lingual. Similarly, the proximal surface of bicuspids and molars, *Fig. 3,* may be divided by the line "a-b," which arises at the gingivus in the bucco-gingival angle and cuts this surface, emerging a little gingival to the linguo-occlusal angle and by a second line, "c-d" which arises at the gingivus in the linguo-gingival angle, crossing the surface to emerge slightly gingival to the bucco-occlusal angle, thus dividing the proximal surface into equilateral triangles, respectively, the buccal, lingual, occlusal and gingival.

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[3] Black, G. V.—Operative Dentistry.

The labial surfaces of incisors and canines and the buccal surfaces of bicuspids and molars may also be so divided by the lines, "a-b," arising for the molars and bicuspids, *Fig. 3,* at the gingivus on the mesio-gingivo-buccal angle, crossing the buccal surface and emerging at the disto-bucco-occlusal angle, crossed by the line "c-d," which arises at the gingivus in the disto-gingivo-buccal angle and emerges at the mesio-bucco-occlusal angle, dividing the surface into triangles, the gingival, occlusal, mesial and distal.

For the incisors and canines, *Fig. 3,* the line "a-b," arises at the gingivus in the mesio-gingivo-labial angle, crossing the labial surface to emerge at the disto-incisal angle, crossed by the line "c-d" which arises at the gingivus on the disto-gingivo-labial angle and crosses the labial surface, to emerge at the mesio-incisal angle, dividing the labial surface into triangles, the incisal, gingival, mesial and distal.

It is obvious that damage to the cement line can come from two sources, viz., mechanically from foods under bite stress, pumping or laving out the cement and joint contents, and chemically from a solution of cement due to acidity of saliva and mucus, whether local or general. The incisal and occlusal triangles include the areas of damage by bite stress, and may be termed *the vulnerable mechanical areas;* where the lines arise in the labio-bucco and linguo-gingival angles and the incisal half of the gingival triangle are the most dangerous to the cement line from local acidity, and may be termed *the vulnerable chemical areas.*

Certain areas in normal mouths appear more immune than others to cement solution, as the labial, buccal and small lingual triangles and particularly the lower half of the gingival triangle, which is sheltered by a healthy gingivus, of which more will be said later, for, indeed, it is the only shelter for this line where there is general mouth acidity.

The application of these lines should not be made too literally, and they cannot be drawn "hard and fast," as they are subject to change in inter-proximal contact, gingival recession and the curvature of the embrasures for the proximal, and lip and cheek contact for the labial and buccal, but they give a most valuable general idea to the operator in cavity preparation.

For instance, if we take the classification of butt and lap-joints and apply the rules of these areas we find from the study of a large number of specimens both in and out of the mouth, that in:

Butt-joints, Fig. 4-A, usually porcelain inlays, after a period in the mouth dependent on mouth conditions to be mentioned later for

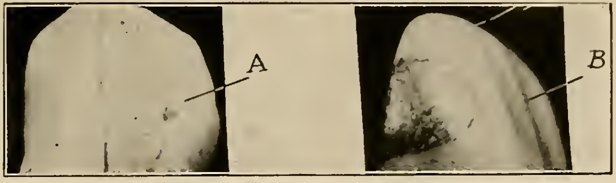


Fig. 4

Fig. 4—"A" butt-joint in porcelain inlay, and "B" lap-joint in gold inlay before exposure to mouth fluids and bite stress; presented for comparison with those showing use in mouth.

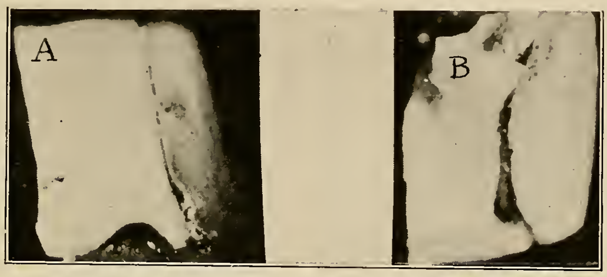


Fig. 5

Fig. 5—"A" lingual and "B" labial view of a porcelain inlay in bad mouth environs six years. Note the heavy bite stress shown in the enamel of the incisal edges. When set these butt-joints were above the average. Note the damage in the vulnerable mechanical areas and all down the lingual; the solution at the gingivo-labial angle and yet the washouts were not deep nor was recurrent caries noted.

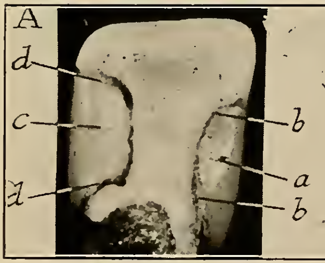


Fig. 6

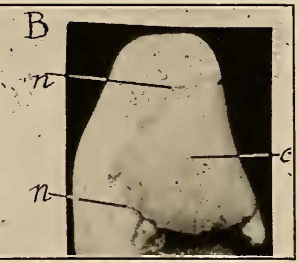


Fig. 7

Fig. 6—The lingual view of a lateral incisor containing mesial and distal porcelain inlays placed at the same time. The mesial "a" lapped the adjacent central and was sheltered from the bite pump. Note the fairly good joint at "b" after three years. The distal inlay "c" was thus obviously more exposed to the bite with resultant joint damage at "d."

Fig. 7—Proximal view same tooth, porcelain inlay "c." Note the very good cement joint on the labial at "n." The gingival caries seen in both these pictures is due to rapid recession, is recent, and has nothing to do with the crown conditions, which were maintained for three years.

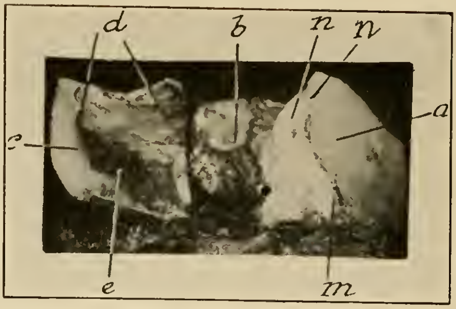
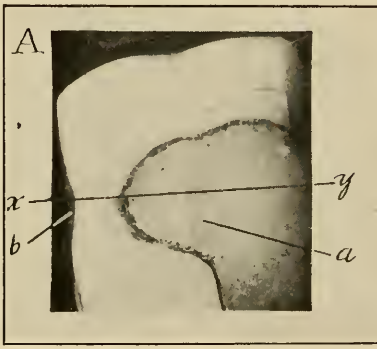


Fig. 8

Fig. 8—Showing a large mesio-occlusal porcelain contour; superior first bicuspid at "a," which fortunately split in attempting an occlusal section through it, and a disto-occlusal amalgam filling at "b;" "c" represents the cut occlusal portion of the buccal enamel; "d" the cavo-surface enamel parted from "a" and containing some cement; "e" the darkly stained wall from "b" amalgam filling. Note the washout on cement line being greater on the bucco-occlusal at "n" than the solution at the bucco-gingival angle at "m" from acidity.



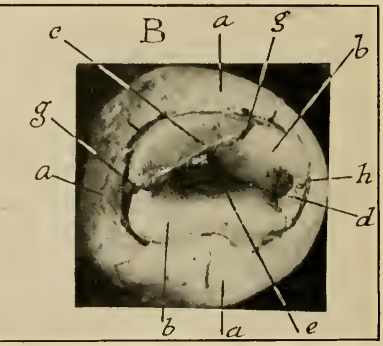


Fig. 9 Fig. 10

Fig. 9—Lateral incisor, large porcelain inlay at "a," time in the mouth about five years; cohesive gold filling at "b" placed some years before porcelain; stained with eosin, cut to section line x-y and honed; mouth of the erosion type.

Fig. 10—Section cut at x-y retained in cement "a." Porcelain inlay section at "c," enamel and dentin at "b," gold filling section at "d"; dark area, stained cement at "e." Note the depth of washout at "g" and leakage and recurrent caries at "h."

Proximal Cavities in Incisors and Canines, just as the operation invades the *vulnerable mechanical area* or incisal triangle, *Figs. 6* and *7*, so is the cement pumped out sometimes to the entire depth of this triangle, or one-third the axial walls, *Fig. 5-A;* no matter how slightly the joint is exposed in the area to the lingual there is always loss of cement frequently clear through to the labial wall, with consequent loss of cavo-surface enamel and fillings edges, *Fig. 5-B;* there is one exception in these areas where large restorations, as the whole incisal third in canines and incisors or occlusal third in bicuspids, are made in porcelain; here butt-joints do well on the buccal and lingual in bicuspids and the labial in incisors and canines where parallel to the incisal and occlusal surfaces the cement line is sheltered from the bite pump by a wall of porcelain opposed above it; the lingually-exposed joint is quickly pumped out and soon stands as does the enamel, alone.

Proximal Cavities in Bicuspids and Molars — Here, with even greater force, the rule for mechanical areas applies to the occlusal triangle, *Fig. 8;* frequently gold inlays with butt-joints are seen in this location, but whether gold or porcelain we find the cement pumped out down along the axial wall, often over the pulpal wall, and always washed entirely from the bucco-and linguo-occlusal angles.

Labial Cavities for Incisors and Canines in the incisal triangle—The cement line does well except in erosion mouths (to be classified later), where the cavo-surface margins disappear as though brushed away, leaving the filling "high and dry." *Fig. 9.*

Bicuspids and Molars—In the occlusal triangle the line suffers from bite stress just in proportion as the inlay invades that triangle, and as the tooth, particularly the inferior, tilts to the occlusal, *Fig. 3.*

Caries can and does recur after this laving process, *Fig. 10,* when shelter is afforded for attachment of plaques, deep under the caval walls; the rule being that when the cement has laved below the depth of the enamel rods in mouths prone to caries, it begins at any shelter on the axial dentin.

Butt-joints—In the vulnerable chemical areas named, the labio-bucco and linguo-gingival angles and the upper half of the gingival triangle, or, in other words, in the usual retention centers dangerous to all contact operations, the cement line suffers, *Fig. 11,* from recurrent caries every time a chemical solution of cement occurs to the depth of the enamel, *Fig. 12,* but the percentage of its occurrence to any great depth is much smaller than the "wash-outs" in the vulnerable mechanical areas, just as the percentage of recurring decay is very much less for inlays than for contact operations in these dangerous areas, *Fig. 13;* this we may account for later dependent upon a number of modifying factors, local and general.

This is just where the variation for inlays previously mentioned comes in, from the rules of Black, for contact operations; due to this fact it is here laid down as a rule that in butt-joints, or, in other words, porcelain inlays, for no judicious operator would use a butt if he could make a lap-joint, the cement line should not be extended any further out into the embrasures proximally, and particularly not extended into the incisal and occlusal triangles, than is absolutely necessary for removal of damaged tooth structures; in other words, the butt-joint operation should be "extended to prevent" as little as possible, *Fig. 8,* as there is more danger from the mechanical areas named in "pump out" of cement, *Fig. 5,* than in the chemical areas named from solution of cement, *Figs. 6* and *7,* all of which is directly opposed to the correct rules for contact operations.

Mention has been made of the shelter afforded under the normal gingivus, for here the butt-joints, as indeed joints of all operations, are at their best, and a word is necessary as to the causes for that immunity. In a report made on "The Behavior of Certain Metals in the Mouth,"[4] the writer found all vulnerable metals as gold alloyed with zinc in solders and gold-plated german silver, as "D" bands in orthodontia, showing deep destruction of the metal just at and above the gingival margin and perfect conservation of the metal as when first placed below the gingivus; this occurred only in the normal gingivus; any irritation from fitting the band interfered with this function, when the metal was quite as much eroded as that exposed to the dangerous line directly above the margin.

It was further proven that vulnerable metals, when in fixed actual, but not pressure contact with the mucosa, were not affected by the degeneration from mouth juices, which quickly attacked them at exposed parts. This was shown by a series of experimental bridges, the saddles of which, made of vulnerable metals, were placed in contact with the membranes covering the ridges; removed and examined from time to time it was found that they were clean and unchanged, where in good contact, but the exposed edges buccally and lingually were eroded. It was reasoned and so reported,[5] that this immunity might have been due to the alkalinity common to all normal mucosa, but more than likely it is an illustration of the immunity conferred on all of the mouth mucosa by the constant chemiotoxis of the leucocytes. Movable membrane contact is most damaging in carious environs, witness the record written on many buccal surfaces of permanent molars as they erupt and are exposed to it in the child mouth—due to the retention afforded by the cover of the commissures. The long record of both butt and lap-joints in crowns carefully set without irritation under the gingivus, is most convincing; the cement line will stand under the protection of the gingivus in the butt-joints of comparatively flat copes of all porcelain crowns and in the lap-joints of banded crowns, the best of which are far inferior to the poorest joint made in the inlay; this might be explained, to a degree, by the protection afforded the cement by crown contour from bite stress, but for the fact that as soon as gingival recession occurs, caries recurs promptly proximally, which is also true of all operations in this locality in carious mouths. But whatever the cause for this immunity afforded by the normal gingivus, all agree that it exists, and that all operations should be put under its cover without damage to it, when possible.

Lap-joints, Fig. 4 B, when correctly made with the metal ductile enough and in sufficient bulk to be well "spun" and burnished over the cavo-surface angle retaining and protecting the cementing media, this grinding over and burnishing doing damage to but the finest external line of cement, the rest of which is protected thereby, *Fig. 14,* are

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[4] Grieves, C. J.—The Behavior of Certain Metals in the Mouth. Proceedings, National Dental Association, 1909.

[5] Grieves, C. J.—A Review of Bridge Work.—*Dental Brief*, Sept., 1910

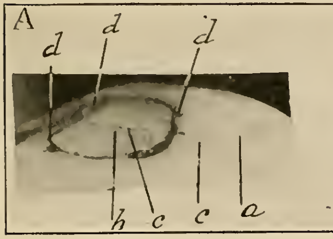

Fig. 11

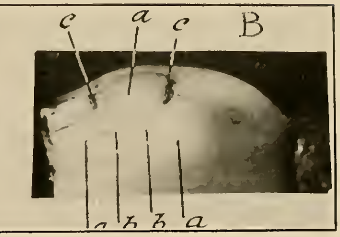

Fig. 12

Fig. 11—Small disto-proximal filling left superior canine stained with eosin; in use twelve years; "a" enamel, "b" porcelain filling. Note that the same drying crack "c," which split the enamel after excision, continues on through the filling, and the filling is well retained, notwithstanding the ugly washouts at "d."

Fig. 12—A section cut out of same tooth and filling on through the labial at "a" to show the state of the caval cement, which is good at "b," and the dangerous looking washout shown at "d," Fig. 11, are of little depth, the eosin stain having gone only as far as "c."

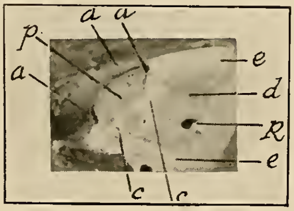

Fig. 13

Fig. 13—Section without staining cut through proximal porcelain filling, lateral incisor; time in mouth, 13 years; "e" enamel, "d" dentin, "r" pulp cavity, "p" porcelain filling. Note the perfect condition of the cement at "c," notwithstanding the open washouts at "a" in the butt-joint, which has undoubtedly been protected by the contained film.

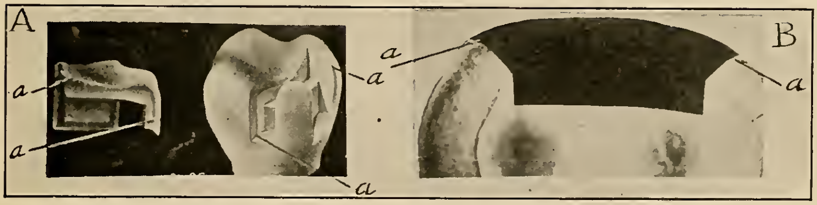

Fig. 14

Fig. 14—From Conzett's article, "Gold Inlays," *Items of Interest,* to show ideal lap-joint at "a."

From Black's "Operative Dentistry," wrong lap for foil operation but right lap for gold inlay at "a."

the writer's ideal, and in his judgment, a long step to the final solution of this problem. *Fig.* 15, after a long and careful study of lap-joints tested side by side with butt-joints, often in the same filling, *Fig. 17.* In both the mechanical and chemical areas, they present conditions which are most satisfactory, *Fig. 17.* There is little or no loss of cement from the lave or bite stress, for the reason that it is sheltered under the cover of the properly finished "lap," hence we may follow the laws of Black and extend occlusally, *Fig. 16,* and into

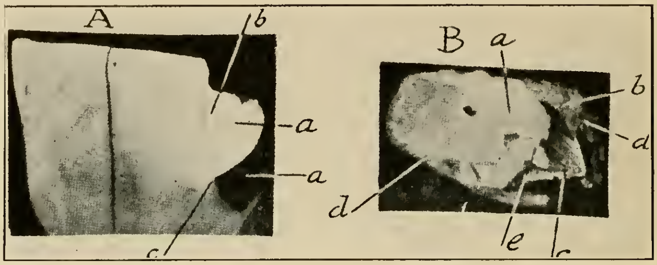

Fig 15 Fig. 16

Fig. 15—Section gingival third gold inlay disto-proximal right superior central, showing ideal butt-joint conditions; "a" gold inlay; "b" dentin and cement, "c" butt-joint.

Fig. 16—Section at the linguo-occlusal angle superior first bicuspid, showing successful long lap joint of a gold inlay, mouth environs bad; time, nearly four years; "a" cross section of enamel of the linguo-occlusal angle, "b" lap joint, "c" body of inlay, "e" cement in joint complete almost to cavo-surface angle, "d" investing cement to retain parts while honing.

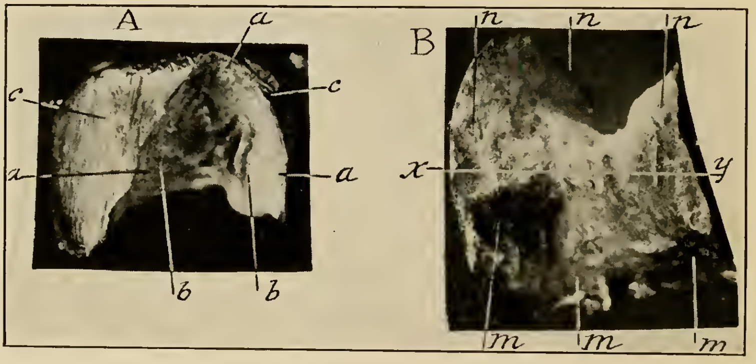

Fig. 17

Fig. 17. A —*Lingual view* of a mesio-disto-occlusal gold inlay, right superior first molar in use six years; "c" gold inlay surface, "b" caval cement in good condition because of perfect protection of the lingual wall by good lap joints at "a."

B —*Caval view* of same filling. The caval cement is intact on the lingual filling surface at "n" to the line x-y dividing the inlay mesio-distally. The buccal wall was protected only by a butt-joint and it will be noted that all of the caval cement buccal to the line x-y is either washed out or stained at "m."

the embrasures; again, when the lap is properly finished—at no time an easy thing—the loss of cement by solution in the dangerous chemical areas is slight. While, of course, in these areas, under certain mouth conditions, all operations fail, they stand up just as much better to the attack as the butt-joint stands better than the contact operation, *Figs. 17* and *18*. The metal in the lap-joint must meet all requirements for perfect contact finish; there is only one such in the opinion of the writer, and that is pure gold, alloying of which seriously interferes with marginal adaptation, just as it does in foil operations, *Fig. 14;* in fact, one of the principal arguments for the lap-joint is to be found in its perfect protection of the enamel rods of the cavo-surface angle. The failure of the lap-joint is largely one of technic, and occurs, strange to say, just where the butt-joint is at its best, under the normal gingivus; a greater number of failures are here to be reported than at any other point, for the evident reason that the correct setting and finishing of the lap under the gingivus without damage thereto or "over-flange," causing retention, is one of the most difficult procedures in operative dentistry, *Fig. 14*, and needs much betterment.[13]

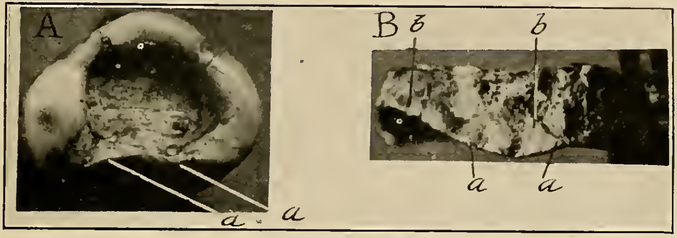

Fig. 18

Fig. 18. A—Looking into an occlusal cavity in a molar filled four years with lap-joint gold inlay, of which a section has been cut at the disto-buccal cusp, showing perfect condition of cement at "a," in fact, through the whole cavity.

B—View of the linguo wall of the inlay which filled cavity shown in A. Note the lap joint which has stood heavy morsal stress with the loss of but little cement at "a," the rest of the cement "b" is in good shape.

It might be appropriate in this connection to mention the method applied by Levi C. Taylor, for small operations, as of building the filling of gold, usually of the crystal types, in the midst of setting cement to a moderate lap-joint, *Fig. 19;* a number of such have been examined, and they seem to combine the advantage of both the inlay and contact operations, also amalgam fillings after this method built of quick-setting alloy in slow-setting cement, *Fig. 20,* with the help of an oiled matrix, finishing to the least bit of a lap of the cavo-surface angle; under particularly unfavorable mouth conditions these fillings do well, and the writer believes that every amalgam filling should be thus cemented in.

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[13] Lane, J. G.—A Comparison of Differences of Opinion.—*Dental Brief*, Feb., 1911.

Reference has been made to the vulnerable chemical areas, and we find mouths where all areas are vulnerable, in others chemical solution is localized; when we realize that the cement-line is continually bathed in saliva, a fluid constantly changing to reflect systemic conditions, some classification of mouth types, broad and necessarily defective, though it may be, is here necessary, to a further study of the subject. While comparatively little is known of mouth conditions—for instance, caries of the enamel is yet unsolved—certain data is at hand, thanks to the efforts of many authorities, particularly Miller, Williams and Black, Michael, Kirk and Low, and the writer presents this diagrammatic scheme with apologies to these investigators.

We may divide mouth types systemically into the Normal, the Hypo-acid and Hyper-acid, as follows:

SCHEME OF MOUTH TYPES AS ASSOCIATED WITH THE SYSTEMIC STATE

NORMAL

MOUTHS—Can be kept clean.

SYSTEMIC CONDITION — Biochemical changes equally balanced.

SALIVA—Neutral or alkaline.

MUCUS — Alkaline; medium in amount existing independently in ropes depositing on all surfaces.

SULPHO-CYANATES — Normal, glycogen and ammonia little or none.

CARIES — Medium in amount, dark and slow.

EROSION—None.

SALIVARY CALCULUS — Medium at the usual points.

SERUMAL CALCULUS — None, frequent sulphid and other stains.

FILMS ON TEETH—On all surfaces except occlusal; alkaline or acid according to percentage of glycogen, protective except in retention centers.

INLAYS do well, and butt-joints stand, but often stain; suffer most in the stress areas, slightly in the rentention centers. Figs. 5, 6, 7, 11, 12, 13, 21.

HYPER-ACID

SYSTEMIC CONDITION — Oxidation low; increase in organic acids; Biochemical changes slow; Arthritism, showing in two phases, Erosion and Pyorrhea.

"A" EROSION MOUTHS—Which look "too" clean.

SALIVA—Acid from acid sodium phosphates, clear and limpid.

MUCUS—None, that secreted is in solution.

SULPHO-CYANATES in excess.

GLYCOGEN below and AMMONIA above normal.

CARIES—None.

EROSION—In excess on cheek or lip contact.

SALIVARY AND SERUMAL CALCULUS — None, no sulphid nor other stains.

FILMS ON TEETH — A few growths open to the wash of saliva.

INLAYS—Look well but fail, particularly butt-joints from all around solution of cement due to the acid-sodium salts; other operations do well. Figs. 9, 10 and 22.

"B" PYORRHEA MOUTHS—Teeth dirty cervically from gingival waste and calculi.

SALIVA—Alkaline from tissue waste.

MUCUS — Sulpho-cyanates, glycogen and ammonia above the normal.

CARIES—Little, considering the numerous retention centers caused by gingival recession.

EROSION—None.

SERUMAL AND SALIVARY CALCULUS — In excess and recurring; staining from all causes.

FILMS ON TEETH — "Materia alba," greasy, alkaline.

INLAYS and all fillings do well except in marked retention centers; butt-joints stand almost as well as lap-joints, but stain.

HYPO-ACID

DIRTY MOUTHS—Cannot be kept clean.

SYSTEMIC CONDITIONS—Oxidation high—decrease in organic acids; increase in excretion of saline chlorids.

SALIVA—Neutral as secreted but acid, thick and ropy; odor and color from the Mucus—which is abnormal, containing a high percentage of carbohydrates as excreted, highly acid, forming sordes.

SULPHO-CYANATES—And ammonia below normal.

GLYCOGEN—Greatly in excess.

CARIES—Excessive, rapid, white, and always recurs, no matter what the operation.

EROSION—None.

SALIVARY CALCULUS—In excess.

SERUMAL CALCULUS—Occasionally, sulphid and other stains in excess.

FILMS ON TEETH—A "thick acid felt" everywhere; the ideal media for B. acidii lactici.

INLAYS WITH LAP-JOINTS do better than contact operations; butt-joints fail quickly, caries recurs at all points on all operations

While it is most desirable that the individual operator should have an intimate knowledge of salivary analysis, so intricate is the subject at present it is hardly to be expected that he can apply it to his daily work; the foregoing scheme shows the principal mouth types, and a close observer may, by carefully noting conditions, read the record written on the teeth and gingivus as a geologist reads the rocks, and reach a fairly accurate conclusion of existing mouth conditions.

Thus, it will be noted from the foregoing, that caries does not recur in the mouths of erosion at all and rarely in those of pyorrhea in the division classed systematically as Hyper-acid; that for instance, in the erosion types there is a coincident lack of the carbohydrate element and an excess of sulpho-cyanates coupled with an absence or rapid solution of mucus, the saliva is acid because of the acid sodium and calcium salts secreted as a content of the mucus, *a systemic acidity*.

On the contrary, in the mouths classed systemically as Hypo-acid, dental caries is rampant; here the carbohydrate element is far in excess, as is the mucus, which is abnormal in quantity and quality, being thick and ropy, with the sulpho-cyanates coincidentally below normal, the saliva is again acid from the decomposition of the carbohydrate element excreted with the mucus; *a general bacterial acidity*. Lying between these extremes, and gradually merging into each, according to the variation in diatheses, is the normal, where the body processes, and consequently the excreta, through the saliva, are equally balanced, the saliva is alkaline or neutral in reaction, caries occurs, but does not recur except when retention centers are produced for the decomposition of carbohydrate foods, producing areas of *local acidity*.

As all junctures between filling and tooth, and butt and lap-joints are no exception to the rule, bear much the same relation to incipient caries as do enamel faults and fissures, often creating immediately retention centers of the worst type, a better understanding is needed of the enamel surfaces, and more particularly as to what actually covers them to the dissipation or conservation of the cement line; the writer is fortunate in being able to recall to your minds these conditions in words other than his own.

Miller[7] tells of a film of micro-organism which covers the surfaces of all teeth, from 100 taken at random out of 1,000 teeth in two different experiments, and stained by eosin and the Gramm method; he says: "I was surprised at the universal presence and extent of the films; of the molars and bicuspids, only the cusps, and usually a small portion of the buccal, and less of the lingual surfaces, were found free from films; of the incisors and canines, the labial surfaces showed a film without a single exception; at the neck of the tooth, where the enamel was completely protected by the gum, there was no film. * * * Fissures, grooves, pits and depressions of all kinds are indicated by

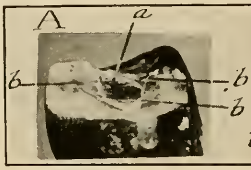

Fig. 19

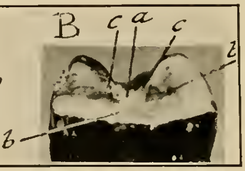

Fig. 20

Fig. 19. A—Section cut through an occlusal filling of crystal gold condensed into setting cement, extracted and stained; "a" gold filling, "b" cement which is perfect. Note the conditions at the cavo-surface angles.

Fig. 20—Similar section through an amalgam filling made after the same method, same time in the mouth, similarly stained; "a" amalgam, "b" cement, owing to contraction of amalgam stains at "c", but no caries.

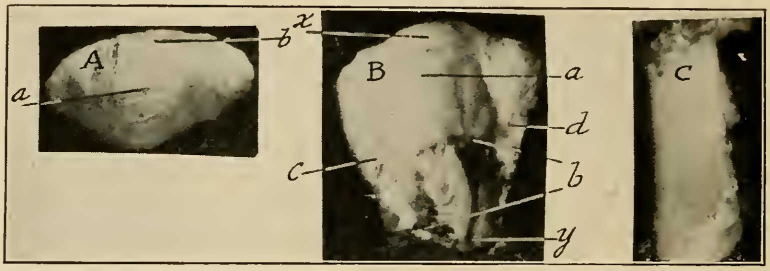

Fig. 21.

Fig. 21—Caval and lingual views of a large porcelain contour in a normal mouth about two years.

A—The gingival seat. Note that the only loss of cement is at "b" where the porcelain is exposed from solution just at the gingivus; "a" cement intact.

B—The entire pulpal wall from x gingival to y incisal; the cement "a" is perfectly preserved except at "b," where it is stained from exposure due to pump from bite stress in the incisal triangle. Note the little solution on the labial wall at "c" as compared to the deep washout at "b."

C—The lingual view showing contour and loss of cement shown in A gingivally.

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[7] Miller, W. D.—The presence of Bacterial Plaques on the Surfaces of the Teeth and their Significance.—*Dental Cosmos*, 1902.

deeper staining and denser films. I was curious to see how the teeth of my colleague, Dr. York, who is immune to caries, reacted. * * * * on the whole, Dr. York's teeth, being carefully kept and highly polished, show the film restricted chiefly to the cervical portions and proximal surfaces."

Again he says, in answering the question, Are the bacteria films or plaques restricted to carious teeth? "The question is very easily answered in the negative. They are not characteristic of carious teeth, but of dirty teeth or rather of teeth whose surfaces are not kept perfectly cleansed by either natural or artificial friction. Teeth which are not kept clean by the process of mastication. teeth without antagonists; loose teeth which oscillate in the mouth, are covered with greasy deposits ("materia alba" of Leeuewenhoek) show most abundant growths; in fact, it would be very difficult to find teeth which did not show bacteria adhering to the surfaces at some point or other."

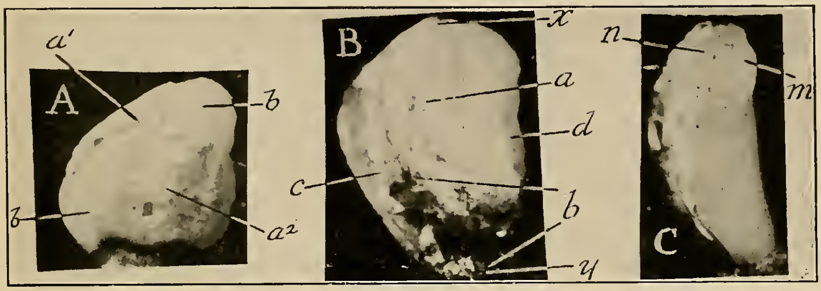

Fig. 22.
(Compare with Fig. 21.)

Fig. 22—Caval and lingual views of a large porcelain contour in a mouth of the erosion type, about two years.

A—The gingival seat. Note the great loss of cement at "b" in the two gingival angles where exposed to acid saliva and its protection by the gingivus at "a" (^{1}); the character of the caval cement at "a" (^{2}) is not as good as in A, Fig. 21.

B—The entire pulpal wall from "x" gingival to "y" incisal; the cement "a" is in poor shape, having lost its retentive value; at "b" it is stained for the same reasons as in B, Fig. 21; it is completely lost along the entire labial and lingual at "c" and "d," allowing entrance of light rays, producing perfect color but proving the solvent power of a saliva loaded with acid sodium salts.

C—The lingual view showing contour and complete loss of cement from "n" to "m" on the linguo-gingival angle.

Later he says, "We may put it down as an axiom that films will be found wherever the surfaces of the teeth are not kept free from deposits of mucus, epithelium, food, etc.," *Fig. 23*.

Lastly, in discussing the existence or the gelatinoid plaque, he remarks: "If the food accumulated on the surfaces or in the cavity undergoing fermentation, it is readily conceivable that a special growth of bacteria in immediate contact with the surface of the teeth would intensify the action at that point, though fermentation itself would certainly not be solely dependent on such growth; if there is an accumulation of nitrogenous food, or if the surface of the tooth is coated with a greasy layer of mucus, epithelium, etc., there will be putrid decomposition with alkaline reaction, which again may be most intense directly on the surface. *In such cases it is conceivable that the film might serve as a protection to the tooth.*" (The italics are mine.)

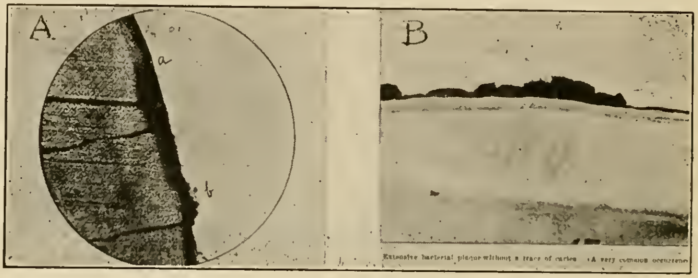
A
a
b
B
Extensive bacterial plaque without a trace of caries (A very common occurrence

Fig. 23

Fig. 23—From Miller's "The Presence of Bacterial Plaques on the Surfaces of the Teeth and Their Significance," *Cosmos*, 1902, showing that films may occur without caries.

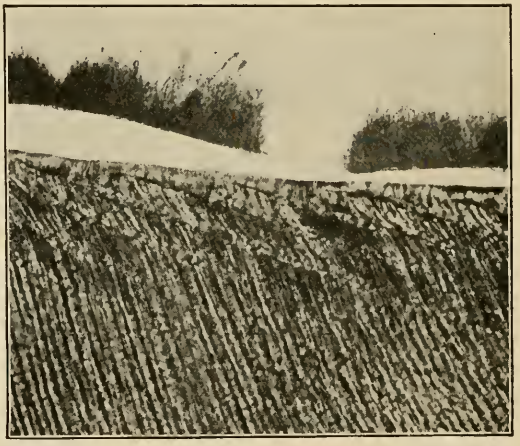

Fig. 24

Fig. 24—From J. Leon Williams' "A Contribution to the Study of Pathology of Enamel," *Cosmos*, 1897, showing film present on all teeth.

You will note that Miller describes these films as covering all teeth, normal as well as carious, the film consisting of mucus (to which Kirk, Lohman, etc., give 25% carbohydrate and 75% nitrogenous-moiety), epithelial scales, organism, etc., so the decomposition of this film in the normal would be a nitrogenous material, *putrid and alkaline*, protective in all but the retention centers for carbohydrate foods, which would then raise the acidity to the point of decalcification, but if the percentage of carbohydrate in the mucus is raised, as in the Hypo-acid diathesis, lactic acid fermentation takes place in the film and caries becomes general, unless the acid is diluted by the entrance of saliva, due to the porosity of the film.

It is interesting in this connection to quote J. Leon Williams[8] on these films under carious condition. He says: "I have ground more than four hundred sections of enamel in every stage of decay of the teeth—in one respect every specimen has shown precisely the same appearance; lining cavities or covering surfaces where decay has commenced, there is always to be seen a thick felt-like mass of acid-forming micro-organisms. This mass of fungi is so dense and adhesive as to make it highly improbable that enamel is affected except in rare or special instances by any acid other than that which is being excreted by bacteria at the very point where the enamel is attacked." *Fig. 24.*

It will be seen from the above that Williams studied the film in the abnormal. He will not admit that this film may be permeated by a general mouth acidity except "in special instances," one of which we take to be erosion types mentioned before, where the films do not exist at all, or are very slight, the saliva being acid from the acid-sodium salts, the mucus which goes to make films being held in solution; it is interesting to note that these are the very types where the cement line fails most rapidly, so that it would appear that the film is protective of the cement line unless, as he says, acid be formed in and under it or "at the very point where enamel is attacked" under the cover of the film, and this again is most convincing, for it is the other and opposite type of mouth acidity, the Hypo-acid, where the carbohydrate percentage in the mucus is so high as to produce acid fermentation in the film.

Black disagrees sharply with Williams in associating all films with caries, saying: "It seemed that he included all manner of material that contained micro-organisms (practically any material clinging to the teeth contains them), going wide of the line of those forms known to produce caries. He seems also to have included deposits through which water would run so easily that they would be no bar to the washings by saliva; such coatings are found plentifully over the surfaces of teeth of immune persons, and also in others where there is no decay of enamel. Careful study shows that many kinds of deposits upon the teeth present similar appearances when seen in microscopic section to those produced by gelatinous plaques and yet seem to have no influence whatever on the localization of caries[3]," *Fig. 23.*

Black[10] agrees with Williams that general mouth acidity cannot produce caries, and insists that caries is due to a special gelatinoid plaque, saying: "I want it understood that I mean a gelatinous substance. I do not mean accumulations of micro-organisms loosely held together on the surface of the tooth * * * inspissated mucus * * * greasy accumulations or any of these things; I mean a substance that is gelatinoid or gelatin-like * * * not soluble or meltable, as gelatin[9]. I have grown the plaque artificially, have seen it in large numbers, and I am sure that under certain dietetic conditions it is produced."

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[8] William, J. Leon.—A Contribution to the Study of Pathology of Enamel.—*Dental Cosmos*, 1897.

[10] Black, G. V.—Discussion of Miller's Paper: "A Study of Certain Questions Relating to the Pathology of the Teeth." Proceedings, Fourth International Dental Congress, Vol. 1.

Miller and Black thus both agree that films cover all teeth and do not necessarily mean caries.

Finally, Kirk[11] condenses the whole matter thus:

"The catchy formula that 'clean teeth will not decay' is misleading, even if true in the ideal sense * * * *first,* because it is equally true that unclean teeth do not necessarily decay; and, *second,* it is practically impossible to always have clean teeth in the ideal sense. * * * For the reason just stated, dental caries cannot logically or scientifically, any more than from the standpoint of observed facts, be classed as a filth disease. * * * More particularly has attention been called to the fact that fermenting particles of carbohydrate food debris adhering to tooth surfaces is not in itself sufficient to account for the phenomena of caries of the teeth; that the mixed saliva itself contains fermentable substances as it is excreted from the glands, and that this carbohydrate product of nutrition dialyzed from the blood plasma is the element found in the saliva of caries susceptibles which is the normal pabulum of the lactic acid bacteria concerned in the first stages of tooth caries * * salivary composition is a resultant of nutrition, and that in its turn is dependent in a large degree upon food habit."

It is thus shown that the chemical composition of the saliva and the growth and chemical composition of the films forming upon enamel surfaces is dependent upon the nutritional state, and this is most impressive when we find that the cement line is damaged most rapidly and without caries in the erosion mouths of the Hyper-acid diathesis, where there is coincident acidity of saliva and solution of mucus with few films; that it suffers almost as much, attended this time by rapid caries, in the mouths of the Hypo-acid diathesis, where there is coincident acidity of saliva and excessive mucus, acid from its fermenting, carbohydrate content, forming a thick "felt" of acid films, *Fig. 24,* and finally, it is damaged least of all in the normal mouths. where the saliva and mucus are alkaline and films grow freely, but are alkaline from putrefaction of the normal nitrogenous content, *Fig. 23.*

It would thus appear that there is also something mechanically protective against mouth fluids in normal mucus and its films when the film is not acid-producing in itself, Williams saying, "This mass of fungi is so dense and adhesive as to make it highly improbable that enamel is affected by any acid other than that which is being excreted by bacteria at the very point where enamel is attacked," and Black insists on the tough adhesive agglutination to enamel surfaces of the gelatinoid plaque, maintaining that no dilutions can occur from the fluid of the saliva under these growths, *Fig. 24*.

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[9] Black, G. V.—Discussion, Report of the Committee on Scientific Research, Dental Society, State of New York.—*Dental Cosmos,* 1906.

[11] Kirk, E. C.—Editorial: Phophylaxis.—*Dental Cosmos,* Feb. 1911.

So we take it as proven that the only danger to the cement joint would be the excessive acidity of the contained film; the total absence or the continued displacement of the film, or so slight a growth as to allow entrance of a generally acid saliva, and while Black says, "The acidity of the general saliva does not become sufficient to cause caries. Those immune to caries have saliva fully as acid as those intensely susceptible."[3] It must be recalled from the work of Hinkins and Head that cement is much more vulnerable to mouth acids than is enamel.

Relative to the dangers of oral mucus, you are referred to the work of Lohman,[15] who claims that mucus is the direct acting cause of all carious processes, and to Kirk[16] and Miller[18] discussion of this theory, with which they do not at all agree only in so far as has been previously quoted; the writer[6] believes that "If mucus were destructive rather than preservative of enamel continuity, teeth in our race would cease to exist, so thoroughly are they encased by it." Of course, this is the normal mouth mucus, the same no doubt to which Head[1] refers when he says of the cement line, "The mucus gets into the fine line and acts as a capillary plug, preventing the constant interchange of solvent fluids."

The presence of a protective film in inlay joints under certain conditions now understood cannot be questioned; as to just how the film protects the contained cement, that needs further investigation.

It is the writer's idea that films fill the crevice left by the earliest washout of the superficial cement almost as soon as the inlay is set. and, as soon as they are retained, alkaline putrefaction begins and the contained film becomes alkaline and discolors. If the film is of sufficient density and agglutination, the cement line is protected until the film is displaced, *Fig. 13*. If the mouth be of the Hypo-acid diathesis, with its high percentage of carbohydrate in the film, acid fermentation occurs in the contained film, the lactic acid attacks the cement, which is alkaline, to solution until the acid is neutralized and the film becomes alkaline and protective; if this is diplaced, as is often the case, the process repeats itself until the "wash-out" becomes so deep and the renewed film so acid, that it cannot be neutralized by the dissolving cement under it, when decalcification of the cavo-surface enamel occurs and caries begins.

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[3] Black, G. V.—Operative Dentistry.

[15] Lohman, A.—A New Fact About Dental Caries.—*Archiv.*, June, 1904

[16] Kirk, E. C.—Editorial: "Mucin as a Factor in Dental Caries."—*Dental Cosmos*, 1904.

[18] Miller, W. D.—New Theories Concerning Decay of Teeth.—*Dental Cosmos*, 1905.

[6] Grieves, C. J.—Report of Work on Base vs. Noble Metals in Orthodontia—*Items of Interest*, Feb., 1910.

It might be argued that the ordinary decalcification of enamel would also neutralize the acidity of the attacking film, and that caries should then cease, and it does, but only to begin again, as all know who have attempted carious cultures; for when the percentage of acidity of the culture media gets too high it must be neutralized by a slight addition of alkalines; it is just this intermittent alkalinity which makes caries of enamel possible, but the amount of alkalinity produc by slow caries of enamel is small when compared with the acid neutralization possible in rapid cement solution.

There are as many stages to this process of maintaining the alkalinity of the contained film as there are gradations from the normal, from the simple neutralization of a slightly acid film, and its agglutination and retention to the dangerous combination in the vulnerable mechanical areas named, where the cement and contained films are pumped out by bite stress, only to be replaced by other deeper acid films, and so on to complete joint destruction.

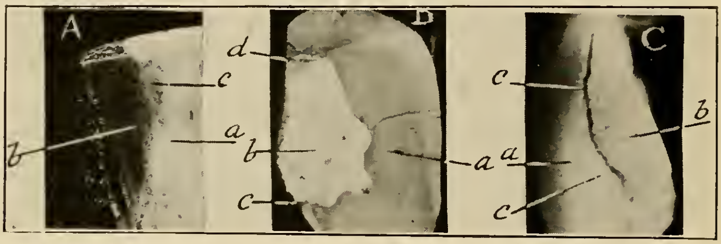


Fig. 25

Fig. 25. A—Linguo-incisal view of one of the best malleted gold contours the writer has ever examined, honed to the dentin; "a" dentin, "b" gold filling. Note the stain from leakage at "c" in the vulnerable incisal angle; time in the mouth, eight years.

B—A cross section cut through a bicuspid from bucco-gingival to linguo-occlusal of the best amalgam filling yet seen by the writer; "a" dentin, "b" amalgam filling, "d" edges failing from bite stress, "c" recurrent caries; time in the mouth, nine years.

C—View of the mesio-buccal angle bicuspid of a well-appearing silicate, six months in the mouth; "a" enamel, "b" silicate filling. Note the open joint at "c."

This is the usual history of the destruction of the ordinary cement filling: in the occlusal areas it is washed and the film rapidly removed; in the gingival areas the film is retained, but in such mass and constantly changing that it is neutralized by the alkalinity of the dissolving cement only to be replaced by a larger film of higher acidity, and there is no retention of film. From a protective standpoint, agglutination of the film and its retention are the most necessary things in inlay work, as shown by all these investigations, and, clinically, the rule holds good, viz., the finer the joint, the less the film; if it be acid, the less to neutralize, and the better the retention of it.

It is now easy to understand how the finest contact operations may fail while the ordinary cement-joint may stand in the same embrasure, for if the contact operation falls short at any point of absolute contact, capillarity acts, fluids enter, and the crevice fills with acid film, *Fig. 25,* which so slowly attacks the cavo-surface enamel that the contained film. instead of being neutralized, receives just the percentage of alkalinity sufficient to maintain caries; in the cemented joint. as has been shown, the acidity of the film acts quickly on the more susceptible substance present, the cement, and the film is made alkaline, *Figs. 10, 11, 12, 13.*

With all these facts in mind the operator may approach a mouth for inlay work with some assurance of his knowledge, first of the diathesis, and by that judge how his work may stand, of the vulnerable areas in cavity preparation, and as to which type of joint he may use, porcelain and butt-joints for appearance when sheltered, or a shelter can be made by insetting gold inlays, in lap-joint, which are always preferable for accuracy and durability.

Finally, the future of the method of inlaying fillings in teeth will be dark indeed, and this, the greatest boon of our times to both patient and operator, will be cast aside as "weighed and found wanting," if we, as a profession, are satisfied with present results As seen in the light of these investigations the field is only just invaded. It will not do to accept the present cavo-surface union of porcelain inlays with the smug statement, "That joints will wash out any way, so wh[illegible] the use?" any more than it will serve to be comfortably pleased with our lap-joints in gold inlays. We are convinced that both butt and lap-joints by suitable technic must be made the equal of those found in the finest foil operations. It is going to demand some of the finest science, art and skill that our profession has ever displayed to do this thing, and we feel assured that in time the skill will be displayed, the science applied, the art demanded put to practice, for never yet have we, as a profession, failed, when convinced of the need, in the accomplishment ofttimes of the seemingly impossible.

SHAPING WAX MODEL FOR CAST GOLD INLAY

BY C. E. ABBOTT, D.D.S.

The following method is of great value in shaping the wax model: "In compound proximal cavities in bicuspids and molars I adjust the medium soft wax to approximate contour and bulk; then I stretch a strip of rubber dam, ½ inch by 2 inches over it and against it, holding the ends taut with the left hand. Pressed against the cavity by the rubber dam, the wax is easily burnished to exact proximal contour, occlusal contact, and smooth surface. I then remove the rubber dam, invest and cast as usual."

SOME PRACTICAL POINTS ON INLAYS

BY L. E. CUSTER, A.M., D.D.S. DAYTON, OHIO

CONDITIONS NECESSARY FOR UNIFORM CASTING

First thing necessary is an investment—a material which will neither shrink nor expand and which will withstand a high heat. For this purpose I have used a material composed of plaster of Paris, one part, and highly calcined fire-clay, four parts. This possesses two advantages over plaster and silex. The fire-clay having been burned at a much higher heat than that used in casting, does not shrink during the latter act. It, moreover, possesses a valuable feature over silex. If silex is examined under a microscope it will be found to present a smooth glass-like fracture, whereas the fire-clay particles present a rough and somewhat porous surface. The advantage is obvious. The plaster ingredient in the mixture should always be as little as possible and a mix of fire-clay and plaster will contain less plaster for a given strength than a like mix of plaster and silex. A cubic inch of the above when brought to a red heat will shrink scarcely a thousandth of an inch, therefore the shrinkage of the average inlay mold would only be about one-fifth of that—too little to worry about.

The second factor is the condition of the mold at the time of casting. It should be thoroughly dried and raised to practically the same heat each time before casting. If the investment has not been thoroughly dried out steam will form at the moment of casting and prevent perfect filling of the mold. It is important to heat the investment quite hot so that any decomposition of the plaster will have taken place. If the gold is cast into an investment which may have been dried out, but which has not been heated up quite well, a slight decomposition of the plaster is produced at the moment of casting and an imperfectly-filled mold is the result. An incidental advantage is also found in casting in a hot mold—the gold need not be heated so hot as where it is cast in a cold mold.

It is important always to heat the gold to as near the same degree as possible. Theoretically, it should be fluid till every recess of the mold is filled, and yet not so hot that it remains longer in a fluid state. Unless the gold quickly solidifies after being cast, although the case may have been dried and well heated, the plaster will liberate gas under melted gold and an imperfect filling will result.

The gold should be cast under the same pressure each time There are practically only two methods of casting—compressed air and centrifugal force. When compressed air is used (steam and gas come under this head) it is important always to have a good surplus of gold so that the edges may be sealed by the weight of the fluid gold, otherwise air will leak under the gold and ruin the casting. The surplus gold in this case, especially where the basin is quite saucer-shaped, does not affect the force with which gold casts as much as where centrifugal force is used. There is no reason, therefore, unless one is hampered by a poor heat, why a good surplus of gold should not be used when casting under compressed air. Where centrifugal force is employed as the casting agent, the conditions are different, and here it is especially important to use about the same amount of gold each time, allowing only for the difference in the size of the fillings. Having once ascertained what amount of surplus gold insures a perfect casting under a given centrifugal force those conditions should be repeated as nearly as possible. The mold is easily distorted by too great a head of metal or by too high centrifugal speed.

APPROXIMAL CONTACT

No feature is so important in approximal fillings as the contact. Heretofore, this has been difficult to secure in malleted fillings, but with the cast inlay it is quite easy, and if the cast filling had no other points of advantage this would be one to recommend it. The wax filling, unless there has been ample room for its finishing, will show a small facet where it touched the neighboring tooth. This should be rounded out with wax, or as I prefer, after casting, to flow a small bit of 22-karat gold upon the facet, thus contouring it out with hard gold at the point of contact.

DO NOT DEPEND TOO MUCH UPON THE ADHESIVE PROPERTY OF THE CEMENT TO RETAIN THE FILLING

There always has been too much faith placed upon the retaining property of the cement. In order that the operation may be facilitated the walls in many cavities that might be prepared almost parallel are quite funnel-shaped in principle. This should not be. Where thin walls surround the cavity it should be kept in mind that these do not serve well to retain the filling and unless these walls are protected upon the masticating edge they will soon spring enough to break up the cemental attachment. We are prone to gauge the retentive property of a cavity by its inside form. We seldom take into consideration the thickness of the cavity wall. The loss of many fillings is due to placing too much dependence upon frail walls.

CEMENTING

If you examine a metal inlay that has come out, as a rule it will be found that the cement has broken its attachment with the tooth substance and is still adhering to the gold. This was probably due to imperfect drying of the cavity at the time of setting. The cavity walls should be thoroughly dried to insure adhesion of the cement thereto. This adhesion can be very much increased by wiping the cavity out with a little of the cement liquid and drying just before setting. This seems to prepare the surface for a stronger adhesion of the cement. We have seen the cement cling to the instrument rather than to the cavity walls at times. This is due to faulty drying out of the cavity. If it is difficult to secure the most perfect dryness it is all the more important to use the liquid method before setting.

RESTORATION OF FRACTURED ROOT BY THE CASTING METHOD

BY J. MAURICE CROSBY, D.D.S., BRADFORD, PA.

Remove the fractured portion of the root, attach a handle to the outside with wax, or better, drill and tap labial surface of fractured portion and attach a piece of German silver anchor-screw wire. This forms a very secure and convenient handle. Oil the inner surface of the fracture. Make a stiff mix of plaster into which press the fractured part of root, inner side downward, to get an impression. When set hard remove carefully. Immerse the impression in water and fill with wax, restore contour of labial surface. Remove and cast. Adapt to the root in the mouth with the crown post in proper position. Wax the inlay to post while in the mouth. Remove, invest and solder post to inlay. Replace in mouth and finish with band and cap as for Richmond crown, or a half band fitting the lingual surface may be made of wax in the mouth; remove with inlay, and cast to same.

SEPARATE BASE FOR A CAST GOLD INLAY

BY F. R. HENSHAW, D.D.S., INDIANAPOLIS, IND.

This applies to those compound cavities in bicuspids and molars, where it is extremely difficult to prepare the cervical portion without extensive waste of the labio-buccal and linguo-buccal margins. Prepare the proximal portion of the cavity so that it will draw, regardless of the occlusal portion. Make wax model and cast this portion of the filling. It is easy to see that you have obtained a perfect contact at the cervix, which is the crucial point in any inlay. Set this portion of the inlay and prepare the occlusal portion as for a simple case. Cast, and set the second portion and the result will amply reward you for the additional labor.

RESTORING TEETH FOR CROWN AND BRIDGE WORK BY CASTING

BY C. J. JENSEN, D.D.S., MT. GILEAD, OHIO.

No doubt every dentist has a method of his own in restoring teeth for crown and bridge work, but I think the most simple way is that of casting by the following method: First, see that the roots are in a good healthy condition, then prepare canals for pins, place pins in position, warm wax. build up and shape wax models so that you can fit crown over same, cut down wax model so as to form a slight shoulder on which crowns rest; this can be done after casting, if desired; withdraw pins with wax model, invest and cast, using Acolite; finish up cast as desired; make band as for ordinary gold crown. soldering piece of gold over end of band. Cement cast in position, then place band over cast, place warm inlay wax on band, have patient bite to obtain perfect occlusion, then carve up cusp, remove crown and cast cusp, finish up crown and cement in place, and you will have a tooth that will be serviceable in every way.

METHOD OF OBTAINING A SHEET OF INLAY WAX SUITABLE FOR USE AS A BASE PLATE

BY NEWTON W. HIATT, D.D.S., MARION, IND.

The inlay wax is melted in small cup, so that the depth of wax is about three-fourths (¾) of an inch. A small round vial is then filled with cold water and soaped well on outside. The thickness of wax depends on the number of times the vial is dipped into the wax. It should be dipped quickly each time. After accumulating the required thickness, the wax on bottom of bottle should be trimmed off, and a warm knife run through the wax the long way of the bottle, when the wax will come off very easily. By warming this in warm water it may be adapted to any shaped model, and removed and cast as any inlay or crown. The object of the cast plate, which is particularly adapted to the lower partial plates, cast in full, or with the use of the lingual bar, is to avoid the making of metal dies, which in some cases is very difficult, and even when the metal dies are obtained it is sometimes very hard to swage, on account of the gold buckling. The cast plate overcomes all this, and can be made to fit any model perfectly.

WAX PATTERNS FOR MOD INLAY

Let us take, for instance, an upper second bicuspid with an MOD cavity closely situated between the molar and first bicuspid. Pack in some gutta percha on the distal side to get some separation, or if there is strong tooth structure at the gingival part of that tooth, use a mechanical separator. Prepare a disto-occlusal cavity, ignoring the mesial part altogether. Extend the occlusal part to the mesial and widen out the end past it in cone-shape form. Carve the wax to make it a disto-occlusal inlay. Into the occlusal part of the wax cut out with a sharp lancet the entire thickness a canal or slot running from the mesial end and terminating in a cone-shape or clover-leaf shape or T-shape at the distal end, so that the wax pattern is really a disto-occlusal inlay, with the occlusal part the form of a fork, one arm of it adapted to lingual, the other to the buccal wall of the tooth. Remove this wax inlay and cast. After the inlay is fitted and finished, fill in that central slot with wax or gutta percha and cement it into place. Now proceed with the other side of the tooth. Get separation in any of the ways mentioned, remove the wax or gutta percha from the slot of the inlay in place. Carve the wax into the mesial cavity, extending it into the canal or slot of the inlay previously provided. Remove wax, cast and cement into place. This inlay will have its retention in that cone-shaped or T-shaped provision made in the first inlay and both will form a well-fitting, interlocked MOD inlay.—*S. Siegel.*

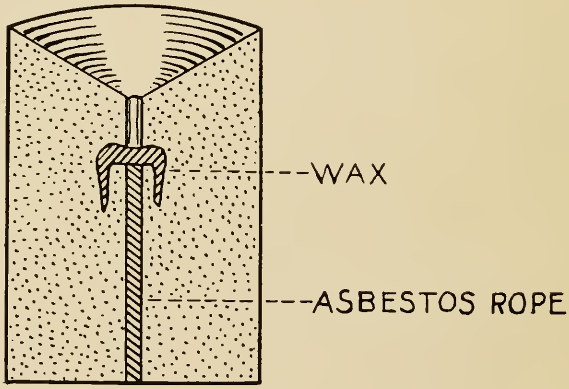
AIR VENTS IN CAST WORK

BY D. D. SMITH, D.D.S., SANDUSKY, OHIO

The first question asked when the cast inlay came into use was, "In making the cast, where does the air get out?"

We know that the air does not always get out.

My object is to show a few ways to overcome this trouble. Some have been using a sprue wire from the base of the investment and not allowing it to come in direct contact with the impression, but withdrawing it a little. In these cases the gold is apt to blow or suck through and thereby make a failure.



If a little asbestos rope (about the size of an engine drill) be dipped into hot paraffin and allowed to cool, it will be of great service in forming air vents in cast work. Pour up as usual and while the investment is still soft insert the asbestos rope. The wax will make the asbestos easier to handle and burns out when heated, leaving a porous passage for the escape of air and gases.

The asbestos may come in direct contact with the inlay wax.

DEVELOPMENT IN THE CAST GOLD PROCESS

BY ALBERT L LE GRO, D.D.S., DETROIT, MICH.

The fundamental principles underlying the process of casting gold will, in my mind, ever remain the same and it is not the latest developments in the process that interest the practitioner of dentistry most, but the latest developments in technic; and with the permission of your honorable committee I will treat the subject from that standpoint.

It is not my purpose to write of the advantages that accrue to the average dentist should he adopt the method of casting gold fillings in his practice, for I assume that from its very incipiency even the most skeptical were quick to see how it would revolutionize certain operations for good in the profession.

At this stage in the development of appliances by manufacturers it is a matter of little consequence which machine you select, though in my mind there is a difference which I will endeavor to show you later.

I have always advocated strict adherence to one method until that particular method had been mastered or found by personal experience to be inadequate. If you are using one machine and your neighbor is using another, it does not necessarily follow that because your neighbor is getting better results than you, that his machine is necessarily to be credited with his success.

In the majority of cases, it is a matter of your neighbor mastering his machine earlier and at the same time developing a technic that is more careful and complete than yours.

Analagous cases are presented in other lines of machinery, such as automobiles, for instance. Two men may have identical cars, one runs his with a minimum amount of upkeep and trouble and the other is always in trouble and finds that his way of taking care of and running his car is causing the expenditure of a large amount of money as well as time. I merely mention this to show that the man who is having trouble with a certain casting machine is by no means in an anomalous or unique position. He certainly has seen or heard of beautiful castings made by the same make of machine that he possesses. so the natural supposition is that he has left some little detail out in the process of casting which brings about his failure and he, not the particular machine, is to be blamed.

INLAY WAX

Before going into the subject of technic I would like to give you the result of my inquiries as to what ingredients should enter the make-up of a perfect inlay wax. I have found that a combination of gum dammar, carnabauer and paraffin in the proper proportions will make an ideal inlay wax that can be carved like a fine grade of clay without distorting, attendant fracture, or the use of warm instruments, a method to be deplored and forever banished in trimming wax inlays.

All except the paraffin are waxes of vegetable origin and can be readily volatilized. The use of beeswax should be avoided, as its addition even in much smaller quantities makes a much softer wax which is more difficult to carve.

Waxes that contain animal extracts such as stearin, spermaceta, etc., should be avoided, as they separate from the compound in heat, especially in a flame, and they tend to make the wax greasy and flaky. Carnabauer is the hardest and highest fusing of the waxes and is added to give the wax edge-strength and hardness, and to make the compound higher fusing. The gum dammar is a hard translucent gum which gives hardness and toughness to the compound. Dammar overcomes the tendency to flake and scale which is characteristic of the wax compounds containing paraffin. The addition of paraffin makes a tough plastic compound which is easier to congeal. A small quantity of ceracin is used to prevent the wax from being brittle and a black vegetable coloring matter is added if desired. A vegetable coloring matter is recommended because it leaves no residue when the wax is burned out. Green should be avoided, as most of the greens which are usable are salts of copper and poisonous. There is a great difference in carnabauer wax on the market. Most of this wax is imported and used for making floor waxes, and while you will find some that is hard as stone, most of it is crumbly and cuts more like an inferior grade of clay. The best grade must be used for inlay wax as the quality of the wax depends largely on the quality of the carnabauer used. I know of no other wax on the market that suits me so well as that manufacture by The Ransom & Randolph Co.; this comes very near to being just what we want. The busy dentist has little time to experiment with matters so small even though he should be thoroughly acquainted with the ingredients and quality of same, that enters into the make-up of such a compound.

That I may more clearly explain some of my theories as to cause and effect in casting gold it is necessary that I treat of the crystallization of the different grades of gold and the metallurgy of that metal to some extent also. If you will take four nuggets of gold of 18, 20, 22 and 24 karats respectively, and bring them to a dancing molten state and then quickly remove the flame, you will notice that the mass of pure gold, in crystallizing, retains practically the same shape in a crystallized form as it did in a fused state. The 22k. will flatten some; the 20k. a little more and the 18k. will be perceptibly flattened. The natural deduction is that the molecules of the gold in the 24k. have the greatest tendency to retain a fixed relative position, and as you go down the scale it becomes very necessary to use more definite pressure on lower grades than on the pure in casting.

The pure gold, the melting point of which is 2012 degrees Fahrenheit, and much higher than the lower grades, necessarily crystallizes much slower than the others. About 30 seconds is necessary for the complete crystallization of pure gold; and right here I would like to tell you why I think some machines are better than others, even though beautiful work is accomplished with any of them. When molten gold is forced in to a cavity, whether it be by air, centrifugal force of steam pressure, each molecule of the gold used is supposed to have a definite relative position. During the first few seconds in the process of crystallization, pressure should be definite to accomplish this, not increased or decreased, and some means should be furnished by the manufacturers of machines that admit of an intelligent understanding by the dentist of what is going on in the way of pressure during the entire process of crystallization. If a machine is not constructed on those lines it should at least admit of the slight increase of pressure from time of application until complete crystallization has taken place. In experiments conducted by myself about a year ago I learned that a definite pressure of 4 pounds, if absolutely definite during the entire time of crystallization, was infinitely more accurate than those that ranged from 30 pounds down, with no fixed pressure at any time. My own supposition is that the molecules were not held in their correct relative position during the entire period of crystallization and though the inlays were just as perfect to the naked eye, they did not fit into the cavity with the nicety that the one of 4 pounds' definite pressure did. Even greater discrepancy is shown in the use of different grades of gold. The common alloys of gold are silver and copper, either one of which tends to make the gold more sluggish than the pure gold. The lines in the finished casting of an alloyed gold are not as sharp and it is therefore not deemed advisable to use anything but pure gold in cavities of extreme shape for it is a rare case that presents no defects when the lower grades of gold are used. If alloyed gold must be used. I would suggest that gold alloyed with copper or platinum or both be used. Copper does not materially lessen the malleability of gold, while at the same time it hardens it. Silver is objectionable at all times as an alloy for gold that is used in casting. It has been recently recommended by some well known dentists on account of the color produced, but it is a mistake to use gold alloyed with this metal, for aside from making the gold very sluggish, it has little edge strength and will not make what I call a perfect inlay in cavities of extreme shape.

With a little experience you can learn to distinguish the alloy in any gold combination on sight. A yellow tint generally indicates equal parts of silver and copper. A red tint, an excess of copper. A green tint an excess of silver. One of the most desirable alloys for cast inlay work is composed of Gold, 22 Dwts., Plat., 18 Grs., Copper, 3 Grs. It is a rather difficult alloy to produce but makes a sharper casting than any other I have been able to find as there is very little oxidation compared with 18, 20 and 22k. golds that are alloyed with silver and copper. I do not recommend this alloy for its ductility or malleability, for, like most of the alloys, it is sadly deficient, but it is much superior to gold alloyed with silver as regards color and will make a sharper casting.

In regard to the latest developments in technic—there are a multiplicity of methods. all of which it is not my purpose to treat. I will confine my remarks to the little hints that my own personal observation and experience have taught me. As you all know, the possibilities of this work are only limited by the skill and ingenuity of the man. So many different possibilities suggest themselves to different men in this work that it would be presumptuous on my part to attempt to tell you of all the new things that everyone has worked out.

In the May and June, 1908, numbers of the *Items of Interest*, are two very intersting papers by Dr. Price, of Cleveland, which are well worth the time of any dentist, and while the deductions of Dr. Price are not verified by my own personal experience, there is much of interest in these articles that show thought and study. These articles come the nearest to working out the problem and are the only papers on casting gold that I have read that exhibit an intelligent knowledge of the conditions as they are.

SECTIONAL INLAYS

These are used only in cavities of extreme shape where the caries has attacked the tooth to such an extent that it becomes necessary to retain all the solid tooth structure that is left. Take a cavity in a large molar approximal, involving the occlusal angle with the *diameter bucco-lingually much larger at the cervical than at the occlusal* portion. The cavity is so large bucco-lingually at the cervical portion that in order to prepare a solid or one-piece inlay, it would be necessary to cut down a considerable portion of good solid tooth structure. To avoid this the sectional inlays or two-piece inlays are employed. These inlays should be made hollow by carving the wax inlay or by the use of suction and heat. I have been using a suction apparatus that is now on the market and while it is a great improvement over the carving, it is quite crude. This defect will be overcome, I have no doubt, as the evolution of casting gold progresses in dentistry. The orifice of the hollow cavities should be so carved that when the two sections are in place the cement will form one solid mass running from the hollow in one section to the hollow in another.

Some one has suggested the use of ethyl chlorid on cotton for chilling wax inlays. I have found it very satisfactory also in rubbing a smooth surface on the outside of wax inlays. When the wax inlay is removed from the mouth it should be washed in soda water to remove the mucus which sometimes produces a surface on the gold inlay that you cannot account for otherwise.

DITTMAR CAST SHELL CROWN

I shall describe the Dittmar method for casting a cast gold shell crown, for I think it the most perfect gold crown ever constructed. If you must put on gold crowns and can get a good fee for them, the Dittmar method will enable you to portray nature as no other method will and at the same time enable you to construct a crown that will give the minimum amount of irritation to the gums. After the root and remaining part of crown have been ground down properly, take 34 gauge pure gold, make band to fit. This gold is so thin and soft that an absolute fit can be burnished slightly under the gum. Trim band proper height for top to be soldered. which completes an ordinary box cap. Have the top and band fit accurately so that the minimum amount of 22k. gold, not solder, will be used to solder the two together. I recommend 22k. gold for soldering for without it, the gold used in casting will melt a lower grade of solder and percolate or rather be forced in fine films up inside of the band. When cap is completed place on root and with modeling compound in a double articulating impression tray, take the bite and impression at the same time. Articulate plaster for articulating side and inlay investment compound for crown side and paint the adjoining teeth with oil. Now heat up a quantity of inlay wax and use camel's hair brush to build up wax on the cap to proper contour and articulation, smooth surface with chloroform, saw off adjoining teeth and then the waxed crown. Invest and cast. The possibilities here are great and most beautiful work can be accomplished.

GOLD AND TIN INLAYS

To use an inlay made of a layer of tin and over it a layer of gold at first thought seems a good procedure, but the only argument that I can see logical in its favor is the economy of gold. A combination tin and gold inlay can have no other particular advantage over a gold inlay for the layer of cement must come between the inlay and tooth substance and all the arguments used in favor of tin at the cervical third or half of the cavity are lost. The ideal procedure is to insert the tin with pluggers, burnish the top and then make a cast inlay of gold to finish the operation. To make a combination tin and gold cast inlay is somewhat difficult, at least it has been so in my own experience. After preparing the cavity a wax inlay is made of the cervical third or half cavity. The top of this wax is made smooth and then oiled. On top of this another wax inlay is made to come flush with borders of remaining portion of cavity and to restore occlusal and approximate contour. This part of wax is then removed and cast, leaving the cervical portion of wax still in cavity. When the occlusal portion is cast the gold is heated slightly, placed in position in the cavity and then withdrawn, when the cervical portion or remaining wax will be seen to be attached to the gold already cast. Now comes the most difficult part of the operation. Gold has a great affinity for tin and the flask holding the investment must be at about an exact temperature to cast the tin. Tin melts at 442 degrees Fahrenheit and is not sensibly volatile, so if the investment is heated until the wax is entirely burned out of the investment and there is no formation of gases continuing and then allowed to cool until about 400 degrees Fahrenheit, melting the tin now with blowpipe, using no more than the required heat of about 450 degrees, a successful casting on the gold inlay can be made.

If these instructions are not followed out, the gold under a greater degree of heat will entirely absorb the tin and a brittle lead colored mass will be the result. Hydrochloric acid must not be used under any circumstances to pickle the filling, as tin dissolves in the acid with the evolution of hydrogen and formation of Stannous Chlorid.

COMBINATION GOLD AND PORCELAIN INLAYS

One of the most satisfactory operations in large restorations is the gold inlay with porcelain face baked in. The inlay is made in the usual way, perfectly with platinum alloyed gold. The wax inlay is carved out or sucked out with heat, and air on the wax corresponding with the portion to be restored in porcelain, with undercuts. After the inlay is made, Jenkin's porcelain is baked in and an esthetic result is accomplished. Before baking in the enamel, place gold inlay in cavity, burnish borders and reduce line of gold on exposed border between margin and cavity for porcelain to a minimum, so that the line of gold will be almost imperceptible when work is finished.

PORCELAIN CROWN WITH CAST CAP AND DOWEL FOR BADLY BROKEN-DOWN ROOTS

This is a branch of the work of Drs. F. Ward Howlett and C. J. Lyons. of Jackson, Mich. They have worked together practically in producing a technic that gives very fine results in these extreme cases of badly broken-down roots. I first saw the work of both these gentlemen, introduced at Indianapolis, early last year, and after mastering it to some extent have gotten very satisfactory results in my own practice. An article on the subject, with detail drawings by Dr. Howlett, appeared in the January issue of The Dental Summary. Every dentist should read it. I will give briefly the technic:

HOWLETT'S CROWN

A bite is taken over the abutment to be crowned with Stent's modeling compound, which is very hard when cold. The compound is then carved to fill the space and imitate the crown to be restored. A thin platinum matrix is then swaged to the occlusal surface of the tooth which has been built up and carved from the compound. This matrix is then removed from the carved tooth and filled with porcelain by a series of bakings which results in a cap of porcelain such as might be stamped from gold in the die plate for a gold crown or bridge dummy. A second matrix of platinum is made on the root stump or abutment and porcelain built onto it, restoring a considerable part of the tooth. This is then placed on the stump in the mouth and the occlusal part of the crown first made is waxed on top of it and the patient forces it to proper occlusion, while the intervening wax holds the two sections of porcelain together and in place. The crown is then removed from the mouth and a portion of the wax removed and replaced with porcelain. Then the rest of the wax is removed and the space filled with porcelain and the whole crown is fused together into one piece.

LYON'S CROWN

Dr. C. J. Lyon's crown, which differs somewhat from that of Dr. Howlett's, though the fundamentals are practically the same, is a porcelain crown with cast cap and dowel for badly broken-down roots. Use iridio-platinum post gauge 20 as a matrix for carrying wax into the root, letting the wax extend over the gingival margin of the root. This should then be carved to form a plate for the crown; a square post should be formed in wax about 5 millimeters long and set in the middle of the plate for the reception of the crown. The wax model of the cap and dowel is then cast in pure gold with the iridio-platinum wire in the center, after which it is polished and set in the root. A platinum matrix is next made of the plate and post by forming a tube for the post and soldering to a square piece of platinum; afterwards it is burnished to a perfect adaptation to the plate and post. A Davis crown is used for the body of the porcelain crown by grinding out a section from mesial to distal large enough to accommodate the post. This is waxed in position over the matrix and all withdrawn and Consolidated body packed around the matrix and fused. After the crown is completed the matrix is removed from the crown and the crown is cemented to the cap and dowel.

BRIDGE WORK

Those who have had experience in casting bridges in one piece will agree with me that it is entirely the wrong procedure and especially where inlay abutments are employed. There is no known investment compound that when set, even under perfect conditions, will expand enough to compensate for the contraction of gold when crystallizing. It is therefore necessary to cast bridges in sections and solder together in order to get exact results.

The fallacy of casting directly onto porcelain, I think, is quite well recognized. Such methods have no other claim to general adoption than that they are an "easy and rapid method or means of obtaining a result which cannot be wholly successful."

In conclusion I will say that it has not been the object of the writer to assume that there is any "only way" in the processes of casting gold, and while the subject given me by your committee is not one on which I could possibly stick to the text, my initial object will be accomplished if this paper but serves as a stimulus to bring out many instructive facts that you all must possess on this subject.

CAST GOLD CROWN

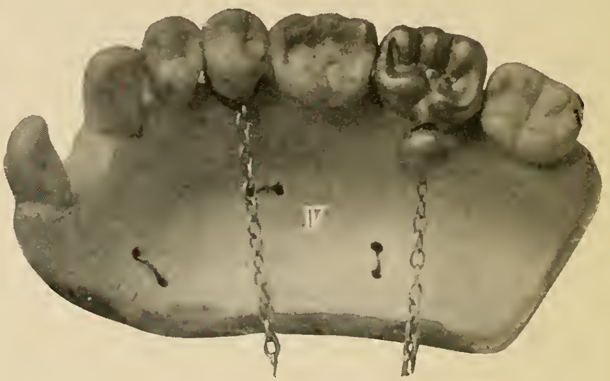
BY C. E. MEERHOFF, D. D. S., CHICAGO, ILL.

Especially adapted for bridge abutments. Trim root, fit band of 35 or 36 gauge platinum (or gold), stove pipe shape. Nip end of bands and bend over root. (*Fig. 1.*)

I

II

III



Have patient bite into wax, giving exact articulation. (*Fig. 2.*)

Carve to correct shape and with bur or suction remove wax from inside as desired.

Pass quickly through alcohol or Bunsen flame, or rub down wax with chloroform to finish or smooth wax. (*Fig. 3.*)

The crown on model has not been touched by buffer or wheel.

ADVANTAGES

Strength—Thickness of metal external to band makes crown unbreakable.

Definite seat—Ease of adaptation of thin metal obviating irritation at gingival.

CAST JOINTED LOGAN CROWN

BY C. J. BURRIS, D.D.S., WASHINGTON, IND.

The jointed Logan crown is by no means new, but is perhaps being used more since the advent of casting. It is especially advantageous in cases where from decay or otherwise the tooth structure has been lost to an extensive degree beneath the gum line.

After the tooth root has been prepared as in cases for the Logan, select a removable pin crown with due regard to size and shape and grind to a joint beneath the gum line on the labial surface only. Then by use of an iridio-platinum pin join the two parts with inlay wax and press to place against the tooth root. Remove and trim away the surplus wax, replace and burnish wax around the tooth root. The crown can now be separated from the pin and wax and the latter invested and cast preferably by the use of pure gold.

This method gives increased strength to the pin as well as the adaptation to the tooth surface; the parts can now be united with cement and when finished are ready for setting.

THE CAST GOLD INLAY

BY JAMES W. LYONS, D.D.S., JACKSON, MICH.

I am pleased to give you the best my feeble ability may permit on this subject which has interested the profession of the world and centered all eyes and thought upon an American dentist and an American city.

I may be unable to advance any new ideas, but I might persent some thought in a light that some one may be benefited in the use of this method.

It is but just to give credit to those few constructive geniuses that are found in our profession. There is not a great number among those who have taken up dentistry as a life work to which we may point in either scientific or mechanical research who stand out pre-eminently above all their fellows, but our ranks are full of men, clean-cut, shrewd and wide awake to every progressive step forward made by the other fellow and capable of applying the ideas and either simplifying or enlarging upon them, cutting and trimming away the corners, or rounding them out, thus making them all the more practical and useful.

It is true that many men's lives are so filled with work that they do not have the time to grasp and assimilate or even to try out the many valuable methods that are created for their benefit. We find a great many dentists who have long been accustomed to following one specific plan in their work. They have, of course, learned by pursuing this plan, to do their work well and comfortably, and rather dread to get out of the rut and accept anything in the way of an innovation.

A departure from the use of foil and the mallet and the adoption of the inlay requires much effort on the part of many dentists.

Two years ago I had the pleasure of presenting a paper on the gold inlay before our society. It is most remarkable the progress made in these two years, and I greatly appreciate, when I read over the paper I prepared at that time, the importance the gold inlay has established among our many valuable filling materials.

ADVANCE BEING MADE

Do you comprehend the advance being made along mechanical and artistic lines by our careful and observing operators today?

To keep apace with the times, is there one thing that makes it more obligatory upon us than to get out and come in contact with the men who are doing things? When I meet and talk with a man who locks himself within his own surroundings his conversation upon dental topics has a like bearing to the knowledge possessed of current affairs by the man who never sees a daily paper.

The gold inlay came to us because within our minds there was a demand for just such an innovation. We receive from mother nature many inventions at just such a time as our surroundng conditions demand them. Our minds become imbued with the desire to accomplish some special purpose and by concentrating thought along that line we develop that for which we are striving. At first our accomplishment may be crude, but by still further thought and by the application of scientific principles it is improved and made better.

Esthetic appearance brought to us the porcelain, which, be it beneficial or be it detrimental, our enthusiasts placed in all cavities regardless of location; but the more conservative men felt the need for a material which would better withstand the battering of mastication.

Manipulatory skill gained with the burnishers in burnishing the platinum matrices to the cavities developed the idea of thus shaping a matrix and flowing it full of the gold and employing it in l molar and bicuspid restorations, by such a material enhancing the value of our operation as to durability and overcoming the friable edge of porcelain. With this inlay of gold we had accomplished much, we had rendered inlay work more practical, and we had achieved much to better our services to our patient, but as we went along in the practice of these methods the only thing we seemed to be gaining was manipulation; we were learning to make closer adaptations, we were studying methods of producing the least amount of shrinkage, methods of producing the hollow inlay and various peculiarities to obtain an ideal form to get the most perfect restoration of lost tooth structure.

When the time became ripe it was left to Dr. Wm. H. Taggart to bring before the profession probably the greatest achievement of the present century, "The cast gold inlay," and you wonder why *you* did not conceive of this system of producing the inlay; but as I have said before in this paper, we find the results of concentrated thought along this particular line. Dr. Taggart spent many weeks and months experimenting before he developed the proper idea of producing that which he sought. He had the completed product in his mind and was working to achieve that particular result with which he was crowned with success.

THE CAST INLAY

The cast inlay is certainly the higher ideal in the gold inlay. At one great stride Dr. Taggart placed all our matrix inlays so far in the background and out of date that they will never be resurrected. What an ideal method, when we can take a piece of wax and shape a wax filling in the mouth, restore occlusion and contour in its most minute form and then duplicate that in gold so that it fits the cavity, to absolute accuracy; it is most emphatically a great triumph in dentistry.

The method is but just in its infancy and yet its field seems unlimited. Almost every day presents some phase in practice in which we can apply the principle with the most remarkable and gratifying results.

Besides the inlay filling, it is admirably adapted to the restoring and building up of badly-decayed roots for the purpose of crowning.

Ideal for anchorage of small bridges, repairing broken Logans, casting cusps, dummies, and for a multitude of uses. If Uncle Sam would just guarantee to keep out of the game we might even be able to retire from the practice of dentistry by casting gold dollars.

But, ladies and gentlemen, talk is cheap—just wait a bit. A few years ago we had men who couldn't find a cavity but what it came under the indications for a porcelain inlay. They even seemed to look with scorn and contempt upon the operator who, a little conservative, had evidence about his operating room that he had use for, sometimes, gold, tin and amalgam.

Today the conservative man has been wise, the other fellow is wiser; if he isn't, some one else has his patients.

We are even again hearing the same class of operators who always grasp a new method and ride it to death as a hobby, making the assertion that the day for malleting in gold and for the old amalgam are gone, that they do not expect to make use of the malleted gold filling again.

It has always been a question with me, upon which I have not as yet passed decision whether these men, faddists, if you please, are really a benefit or a detriment to our profession; my judgment is that they are at least enemies to themselves.

The cast inlay method is a great achievement in art and mechanics and I appeal to you all not to abuse it. By carrynig out this method carefully it does for us what no other method ever accomplished to the same extent. Owing to the absolute accuracy which you *must* obtain, it develops in you, unconsciously, a high degree of skill.

Gentlemen, do you assume the idea that all that is required to make successful inlays is a particular kind of machine? You have much to learn to become an inlay worker.

A gold filling thrown into the tooth most any way, providing you happen to have two opposing angles or pits, *may* stay long enough for the patients to move out of your locality, but an inlay inserted regardless of conditions stays a mighty short time.

The very highest art and skill are demanded in cavity preparation for inlays.

I believe a man will be able to do a very much better gold filling after he has done inlay work for a time, for the reason that his training in the thoroughness of his cavity preparation will instill into him the idea of very superior formation to that to which he has been accustomed.

It has been suggested that the casting of fillings might have a tendency to cheapen our operations. Some men argue that as it is easier on them and does not take so long as to mallet in a filling, our fee should be less. For those men let me say, they should belong to the union labor crowd, where they could operate under a scale of wages.

It is too burdensome to my mind to work out a classification for such men among scientific and skillful dentists.

How unfortunate it is that our colleges cannot wake up to the fact that our profession needs fewer men, and *those* with high ideals, and not great numbers, who as failures in the highest arts in dentistry, might make the very best of machinists or blacksmiths.

This class of work should demand the closest application, plenty of time, and the best of your skill, all of which call for the best of fees.

It is a great mistake with the young men entering the profession in taking up the inlay as an easy method to a result, thinking, by so doing, of abandoning the long, tiresome gold filling, when their experience has been so limited as to be unable to discriminate between the indication for filling or inlay. Their manipulation of filling materials is needed, their judgment and observation more mature.

You will find your patients very appreciative of a method which restores their broken-down molars and bicuspids so excellently to usefulness, with so little inconvenience to themselves.

How much higher the ideal as compared with the gold crown which, at its best, is so ill-fitting around the gingivæ which nature so admirably formed.

How perfectly the inlay replaces so many defective, unsightly and ofttimes poorly adapted amalgam fillings. While amalgam may have been both the patient's and dentist's friend in saving some pretty bad wrecks, yet like the untrue friend. it has been the cause of many wrecks. I hope we may be able to eliminate some of these failures with the cast inlay.

I do not approve of the use of the gold inlay in the anterior teeth, excepting where great stress is brought to bear, as in end to end occlusion, or in opening the bite where abrasion has cut out the lingual surface of these teeth.

The work is very exacting and tedious, but because it can be done in stages it is not so laborious either to patient or operator as some of the older methods, and as far as my observations go, the end to be obtained is nearer reached than by the older method.

We are all amateurs yet in the handling of the cast gold inlay, and finding out every day that there are things yet to be learned which our conceit had attempted to make us believe we knew all about.

CAVITY FORMATION

The first step as with all inlay work is cavity formation, which, as I have said, calls forth all the skill and ingenuity that the best operators possess, if it is properly done. The plan of the cavity should first be mentally mapped out and then executed, if it takes the entire time for one sitting, because upon the proper and perfect forming of the cavity depends the success of the inlay. With the gold inlay it does not require the sacrificing of as much sound tooth structure as it may for the porcelain.

Force and direction of occlusion must be taken into consideration and the inlay set so that these forces have a tendency of forcing it into the cavity instead of out and away from it.

We must obliterate all undercuts that the wax may be drawn from the cavity without the slightest change of form. By slightly diverging walls, angles and beveled grooves, get all the frictional retention you can.

If possible to get, form your cavities wedge shape with flat base or bevel, converging towards the pulp.

The pulpal wall should be as paralled as possible to the surface of the tooth upon which the cavity is located. Saucer shaped cavities, with the dependence almost entirely upon the cement, will fail to hold an inlay for any great length of time, no matter how much time or work you may have put upon the inlay itself. Many discouraging failures in inlay work, I believe. are due to a lack of knowledge or disregard for these principles.

THE WAX INLAY

The next step is the wax inlay. I believe in taking a good generous piece of the prepared wax, for the reason that small portions are difficult to unite after they have been once moistened in the mouth. Soften the wax in warm water, not above 138 degrees Fahrenheit. Do not apply dry heat as it seems to make the wax crumbly. Now press wax to place in the cavity, see that it presses closely to the bottom and over all the borders, then have the patient close the teeth and go through all the movements of mastication, as just the mere fact of shutting the teeth together does not give us correct occlusion.

The cavity needs no other lubricant than the existing moisture of the mouth.

After getting the correct occlusion of the teeth, I begin carving away surplus wax and also with flat burnisher work the wax down perfectly to and over all borders. Asking the patient to open the mouth. I hold the wax in place and carve and shape contours; then by means of cotton pledgets and tape moistened with liquid vaseline, I finish and polish this wax inlay until it is just as near my idea of what I desire in the gold as I can get it. Very often I lift it from the cavity, chill in cold water, trim away feather edges and reset in cavity two or three times before I have it completely finished down. When I consider my wax inlay complete I remove and attach my little sprue wire. I prefer doing it this way to attaching sprue to wax in the cavity. Next, adjust sprue to the little crucible former and proceed to invest. This is another portion of the technic which is very critical and wherein your success hangs in the balance.

INVESTMENT

Your investment must be of material in which the shrinkage and expansion shall be the minimum and not change form whatsoever under heat. It needs to be carefully and uniformly mixed and I have the habit of turning my plaster bowl on its sides and revolving while mixing until my investment is coated all over the inside of the bowl in a thin layer—thus allowing escape of any small air bubbles. Now, I prefer a small spatula to place the investment about the wax inlay, forcing a little investment ahead of the spatula and thus driving the air ahead and out of the corners and depressions in the wax. I build up investment about the wax until it is a thickness of probably a quarter of an inch all around. Now I place investment over all the inside wall of the flask and set with a twisting or rotating movement onto the crucible former, and carefully proceed to fill it full with remainder of investment, not jarring it, as I wish not to liberate any of the amount of air still contained in the investment and by so jarring it would gather together this air and is very liable to collect on the wax model in little air bubbles, which, when your cast comes forth, you discover as little fine nodules of gold, which you wish were not there as it interferes with its being a *perfect* reproduction of your wax.

Now give the investment from fifteen to thirty minutes to set before applying slow heat to dry it out. When all moisture is gone and the wax has been absorbed and vaporized, place in machine, melt pellet of gold and cast. I aim to have the pellet of gold about three times the bulk of the inlay. The heat for melting the gold should be very intense and concentrated, as with the nitrous oxid flame or the electric arc, as the gold should be in as fluid a state as mercury.

CASTING

The casting may be done by any of the machines now on the market, providing you can get absolute accuracy.

In experimenting with the different grades of gold to observe the contraction, I can but recommend that when you desire absolutely the best results, you must use pure gold. Dr. Price, of Cleveland, has done some very fine research work along this line, demonstrating both expansion and contraction of gold and its alloys, also expansion and contraction of our present investment materials, which you will find in the May, 1908, number of the *Items of Interest*. You may cast your inlay with the lower K. gold and get a result which to the operator who is not scrupulously observing might seem to be good, but when you examine for an absolutely perfect adaptation you find it deficient somewhere, owing to the contraction of the metal.

The casting of the hollow inlay has appealed to me because I always looked upon the hollow matrix inlay with favor, and employed it wherever the case permitted me to do so; consequently when taking up the casting I began trying different ideas to obtain the hollow cast inlay. The best method I have found, up to date, is a little copper bulb with a handle attached to one side of it and a small point a little larger than a needle attached to the other side, which is wrapped with absorbent cotton or fibre asbestos; then by heating the bulb hot, enough heat passes into the point so that by touching the wax inlay where I desire the hollow part, the point will melt the wax and the absorbent draw the melted wax away, leaving just as much of a hollow portion as you desire.

The hollow inlay gives us a layer of cement just over the pulp, insulates it from the metal body and eliminates the thermal shock, as where we desire this inlay we usually have cavities which are in just such a location as to be particularly sensitive. They also give us more attachment for the cement which serves to increase the value of retention.

CEMENTING AND FINISHING

When our inlay has been formed and tried to the cavity and found to be perfectly satisfactory, set it with a very fine grained inlay cement and burnish all borders and polish; and if you are like me, you will at this time think of our grand old Professor Watling, when he said, in polishing the gold filling, give it the polish of the inside of your watch case.

SUMMARY

In summing up, let me say, first, make a study of the conditions, with your patient's benefit uppermost in your mind; use the cast inlay if in your judgment the restoration will be the very best that can be done by any known method; if not, then use that which *will* give such a result.

Do not insert the inlay until you are master of the cavity formation and know, *absolutely know*. that the cavity formed will hold it. Know that your wax inlay is as near perfect as you can mold it and get an absolute duplicate in the gold. Do not insert an imperfect inlay because you dislike to do it over again. Be a man and take the bitter with the sweet. Your patient will appreciate your interest in having your work right, but will despise you when he discovers you have deceived him by accepting your fee for a defective operation.

The measure of success we are to meet with lies in direct proportion to the care which we use in the preparation of our work. It is true to the same extent as with any other class of work; a man's individuality, his honesty of purpose, his character, his appreciative sense of his position in his chosen profession toward his services to humanity, are all distinctly shown.

If the operator is not willing to give time and study and research work in experimenting to bring this method under his control that he may better his services to his patients, I would advise him to let it alone. If the same operator is still unwilling to better his services to his patients along even the older methods at hand and still persists in staying in the same old rut at this day, it would be just as well for his patients if Divine Providence should conclude that his services were more greatly needed in other fields.

That which I have desired most to impress upon you is thoroughness.

The dentist who is of the greatest value in his community is the one who is ever alert to every progressive step that will in any way benefit his patient. Such a man is elevating his profession, is making the best of the talents which have been given him, and lastly, doing the greatest amount of good for himself.

CASTING: A RETROSPECT

BY DR. J. G. LANE, PHILADELPHIA

When it first became known that certain areas in Alaska were rich in gold, ravenous prospectors and claim-stakers jostled with and fought each other in their mad rush over the coveted territory. This proceeding was carried on amid such a degree of excitement—each person fearing that each and every other person might find something better than he himself—that the entire field was sort of wallowed over, and worked too superficially to find out what conditions really did exist. After the place was thus imperfectly worked out in the first spasm of excitement, the same ground was again covered in a manner that was sane and sensible enough to unearth the real value of the environment. These same conditions obtain in our profession as often as new or novel procedures and methods are sprung upon us. And the more unique and novel the innovation, the more this condition obtains. In this particular, casting has been an exception only in that it has been the most extreme case of this kind that has ever come within our observation. And now that the first grand rush for supremacy and record is on the wane, it is high time that we begin to look back over the field, take a retrospect view of what has been done, the theories and methods advanced, and to sift the real wheat from the chaff. This sifting and winnowing is likely to send many pet theories and ideas to the wind—never to return; and indeed wisely so. The dental journals—aye, and even the textbooks on the subject in question—tells us all manner of theory and methods in the art; many of these are so unreasonable, fallacious and unscientific in their very aspect, that we cannot but assume that the exponent of such has in all probability arrived at his conclusion theoretically, rather than scientifically or clinically. While we know that the profession as a whole has been wondrously benefited by the result of all this effort, yet we cannot believe other than that many things which have been written and said on this subject from time to time, have proved to be an injury to the cause rather than a help.

Quoting Dr. C. S. Van Horn, *Dental Cosmos,* Vol. LI, p. 549:—"At present our work in this field is largely empirical; we have not practiced casting sufficiently long to have established it on a scientific basis; consequently we are too many times between the devil and the azure brine to know the how and the why. Some day the clouds will roll away." And in accordance with this thought, we think it high time that some of the overhanging clouds should roll.

The purpose of this paper, therefore, will be to point out some of the extremely opposite views that have been taken by various experimenters, who, by experiments conducted technically, theoretically, scientifically, and clinically, have endeavored to reduce the art of casting to a true and proper basis.

Let us consider the impression method for inlay work as advocated by Dr. Weston A. Price, *Items of Interest,* Vol. XXX. p. 363 and 938, and by various other inlay workers. This method has adherents both in the clinic and in literature; the usual arguments advanced in its favor being the lessened possibility of distortion of an impression as compared to a possibility of the same in a finished pattern while being removed from the teeth or cavity; time saved at the chair and less annoyance to the patient. Let us quote your essayist from the *Dental Digest,* Vol. XV, p. 436—"The pattern for a gold inlay should be made in the cavity that is to receive the finished casting. This insures a better adaptation than can be had by any method thus far devised for making the pattern in a model. In the former method we have three transters—cavity to pattern, pattern to investment, and investment to gold. In the latter we have five transfers—cavity to impression, impression to model, model to pattern, pattern to investment, and investment to gold; or, if the casting is done directly in the model we still have four transfers by the latter method. In any transfer we can scarcely avoid losing detail and definition; therefore, the fewer the transfers the better the inlay is going to fit—all other things being equal. Furthermore, there is vastly more possibility of distortion in an impression than in a pattern. This can easily be understood when we consider that the pattern is adapted to the interior of the cavity only; while an impression for a model is adapted not only to the interior of the cavity but also to the exterior of the tooth—as well as to adjoining teeth. Removal of such an impression from the tooth or teeth is almost sure to distort it; nor is there by this method any possibility of determining whether distortion is present or not until the inlay is made. By the direct method there is very little possibility of distortion. or if there is a suspicion that distortion is present, it can easily be proven and corrected before proceeding further." Instead of the impression method amounting to a saving of time at the chair, we believe it to take more time than the pattern method, because of the fact that two operations—one for impression and another for bite—are necessary. And if, therefore, as much time is consumed, the patient has not received the benefit of any spared annoyance. If, as is advocated by some, the model for such a case is to be made of amalgam, and the wax pattern for the inlay then made in the amalgam model, we at once find that the time consumed after the impression and bite have been taken, is very prohibitory—in addition to the almost certain result of inaccuracy on account of too many transfers, and the possibility of distortion. It is, therefore, patent to all that the method which will insure the greatest accuracy of adaptation is the one which is most desirable to follow.

We believe that the more general use of inlays has done much toward educating the profession in general to appreciate a higher standard of cavity preparation. As to fundamental conditions which should obtain in this part of the work, all seem to be pretty nearly a unit. In detail, however, there are wide differences. Let us quote Dr. P. B. McCoullough, *Dental Cosmos,* Vol. LI, p. 1175:—"No filling material has at its square edge the strength of the square edge of enamel. The beveling of enamel margins for protection is illogical when the weaker body is to provide the protection." Let us also quote Dr. Theodore C. Trigger, "Notes and Methods of Filling Teeth with Gold Inlays," p. 46—"The marginal edges of the cavity should be cut straight and beveling avoided." The authority quoted repeats this statement on p. 59 of the same publication. Let us also quote your essayist, *Dental Cosmos,* Vol. LI, p. 434—"The margin of a gold inlay being thoroughly homogeneous is reliable even at an angle of 65 degrees. This secures for the enamel margin the remarkably strong angle of 115 degrees." This seems to be just about the extreme opposite. However, we feel positive that we have seen our contention in this upheld clinically at all times; and we believe that proper clinical results are most important. For inlay work we disapprove of the extremely angular form of cavity preparation generally known as the "Black Method," and by some inlay workers followed out in cavity preparation for inlays. We believe that the inverted cone and square end fissure burs have no place in the equipment for inlay cavity preparation. Quoting again from your essayist, *Dental Cosmos,* Vol. LI, p. 433:—"Sharp angles at the cervico-buccal and lingual aspects of an approximo-occlusal cavity have no point of merit whatever, and serve only to weaken the tooth as a whole." Also quoting Dr. Trigger from the publication mentioned above, p. 59:—"The enamel walls should not terminate too abruptly in short curvatures." P. 60:—"No definite angles are used in the preparation of cavities for inlays." And further down the page, "At the junction of the gingivo-labial and buccal surfaces the cavity should be cut in a rounded form." Dr. Trigger then goes on to state the advisability, and almost necessity. of sharp angular forms in these parts of cavity preparation for gold foil fillings.

Sharp angles at the points mentioned in the quotation of your essayist, have the effect of confining the area of possible fracture to *one* point, while if these parts of the cavity have a very slightly rounding effect the area of possible fracture is distributed over the area thus filled in, and *no one* point will have to endure the entire violence, e. g., a steel bar 3 inches in diameter, having a point at its center cut down by a narrow sharp edged groove to 1 inch diameter will fracture more readily under load than if the entire bar (or even a longer distance in its center) were only one inch diameter. If there are sharp angles pointing outward from the interior of a cavity there will be similar angles in a casting mould; these are likely to receive slight abrasion and injury when the gold is cast past and against them, thus causing a misfit. The more angular the cavity the more difficulty is experienced in getting the inlay properly seated; the surplus cement must follow a more tortuous line to escape. We cannot see that sharp internal angles add in any way whatever to the degree of stability or fixation of an inlay after it is cemented in position; nor can we see how such could in any possible manner strengthen the operation and tooth as a whole. Furthermore, there is a possible element of inaccuracy of adaptation to sharp angles in making the wax pattern.

Much diversity of opinion exists in regard to the temperature the mould should have at the moment of casting. Quoting Dr. Marcus L. Ward, *Dental Cosmos,* Vol. LI, p. 1055:—"We are to cast our gold into moulds which have been heated sufficiently to eliminate all mechanical moisture and allowed to cool down till they can just be handled with the hands without discomfort if we are to place the casting of gold on a practical as well as scientific basis*." Quoting also Dr. C. R. Baker, *Dental Review,* Vol. XXIV, p. 133—"My first conclusion is,—that the only way to cast inlays is in a cold mould. * * * With a cold mould we get a better specific gravity." Quoting also your essayist, *Dental Digest,* Vol. XV, p. 499—"If the flask contains a mould of an inlay for a double compound cavity, or one that encircles or sits astride some portion of the tooth, it should be exceedingly hot at the moment of casting. This will give the minimum of shrinkage with a given investment." And on the following page—"For inlays representing simple interiors, the flask need not be so hot as for the classes just described; but it must always be borne in mind that the lower the temperature of the flask the greater the shrinkage, and that the approximate amount of shrinkage desired shall determine the reduction of temperature in the flask at the time of casting."

Dr. Ward, in the publication quoted, does not seem to give any very definite reason for his belief regarding the temperature of the mould. Dr. Baker states his reason as being that a better specific gravity is obtained. We cannot see that Dr. Baker's figures for shrinkage (or expansion) in the publication quoted (pp. 130 and 131), mean very much unless the size of the pattern for each was given. On the following page we may read:—"The average size of the wax cubes is .1995 in." Unless the patterns had an absolutely uniform and stated size the table would not show much, except by computation if the size of the pattern for each experiment was given. The sizes are not given except as above. Experiment No. 3, Table III, reads:—"5 dwt. hot .2000, 18,308 Pecks," and conveys to us the information that 5 dwt. of pure gold was cast into a hot mould of Peck's investment, and that the resultant casting measured .2000 in. and had a specific gravity of 18.308. No figures are given for the size of the pattern for this particular casting. But if the flasked pattern was .1995 in. we believe that the result as stated is a physical impossibility so far as it pertains to the size of the casting. Experiments that we conducted along this same line to determine figures on shrinkage showed Peck's investment to have a very decided dgree of contraction on being heated to a high temperature. Our figures for the particular experiment that might be placed in comparison with the above are these:—size of pattern .5000 in. (half an inch); temperature of mould,—red heat; size of casting,—.4957 in.; investment, Peck's. This shows a loss of .0043 in. in a casting made in a mould as hot as the fusing point of the brass flask that contained the mould would safely allow. In eleven of the twenty-eight experiments of Dr. Baker we are given figures which show castings larger than the pattern (.1995 in.) anywhere up to .2030 in.—or in one instance an increase of .0035 in., and this in a vacuum machine. Two of the tables given are the data for vacuum machines. The make of vacuum machine is not given, but we assume that it has iron flasks. Iron has an expansion equal to about one-half the expansion of gold; and in order to expand enough to give a casting the size of a given flasked pattern would have to be heated to double the fusing temperature of gold. Of course, the investment would not stand this; and granting that it did, the casting would show a register only after the whole had cooled down to 2016 degrees—which register would be only half enough to neutralize the contraction of the gold. In our experiments the best result obtained in an iron flask, cast at red heat, gave a casting .4943 in. from a pattern of .5000 in. Two other machines mentioned in the tables are Taggart's and Jameson's. These both have brass flasks. Brass expands a trifle more than gold at a given temperature. With these it is possible to get a casting almost the size of the flasked pattern, but absolutely no larger. The highest reading we obtained on castings made in a brass flask, and at a temperature almost sufficient to fuse the flask, was .4992 in. from a pattern of .5000 in. We are strongly of the opinion that Dr. Baker's patterns were not the size he supposed them to be.

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*We are not informed as to just what this scientific basis is.

Increased specific gravity is, indeed, a most excellent feature in an inlay. And we do not take issue with anyone's statement that casting in a cold mold increases the specific gravity of the casting thus produced. We have not experimented along this line but we know that this condition obtains in grey iron. Grey iron cast against, or in, "chills," is so finely crystallized and hard that it cannot be cut except by grinding; and cannot be annealed except by remelting. If, however, the increased specific gravity of a gold inlay be obtained at the expense of accuracy, of adaptation—which feature would undoubtedly obtain from shrinkage if cast in a cold mold—we cannot but see that as a whole an already strong point has been strengthened, and a weak point made weaker. Namely, the density of any gold inlay is more durable than the cement line which surrounds the inlay. Increased specific gravity can be obtained to a sufficient depth on the masticating surface by means of round or corrugated engine burnishers.

Quoting again from Dr. Baker, in the article previously referred to, "If we have a step cavity with a good dovetail in the occlusal we find that that dovetail is going to draw the inlay into position towards the occlusal in such a way that when pressed down or hammered into place in the best possible way there will be at the cervical a heavy line of cement showing. Why is that? It is simply because the cavity is prepared with almost parallel sides, and if this inlay is the same size as the cavity, the cement will take up too much space, so that it raises it." Our observations in such instances have shown that the condition as described is not due to its close fit in the cavity and the interference of cement, but because of excessive contraction of the inlay. When the morsal part of such an inlay is seated on its foundation, the approximal part is not long enough to reach its destination at the cervical aspect of the cavity. Also that the part fitting into the dovetail (if this dovetail be a very pronounced one) is so contracted that it will not allow the approximal part to fit closely against the pulpal wall of the cavity except at the angle of the step. This observation may easily be made, and the facts cited determined, by placing such an inlay in the cavity *without* cement, and see exactly the condition referred to.

We believe that the shrinkage problem in cast gold inlays is not generally considered as important as its clinical results will warrant. Quoting from Dr. Ward, *Dental Cosmos,* Vol. LI, p. 1056: "If, then, a filling ¼ in. in diameter shrinks .0008 in. and is seated in the center of the cavity, there will be .0004 in. to be filled with cement on each side. If the casting be a compound approximal one for a molar measuring ½ in., we can only calculate a total shortening mesio-distally of .0016 in. Imagine, if you will, such a cavity being prepared with its walls inclining sufficiently to enable one to draw a wax impression, and a filling that had shortened from the extreme ends only .0016 in. Do you doubt its going to place? It will do it so closely that the naked eye cannot detect it, if the cavity has been properly prepared. These figures will not hold good for casts made in a red-hot mold, or if the gold is superheated. They hold good for casts made of gold heated above its melting point, and a little below its boiling point, and cast in a cool mold." Also quoting Dr. Price, *Items of Interest,* Vol. XXX, p. 933; "In bridge work, because of the length of the piece, the cooling contraction not only makes the piece too short to reach the abutments, thereby throwing one of them out of register, but, if the attachment encloses a foundation as a ferrule for a root, its decreased diameter will not allow it to go over." In *Dental Cosmos,* Vol. L, p. 940, (Hinman) shows a cut of a bridge with two inlay anchorages. *Items of Interest,* Vol. XXXI, p. 815 (Reynolds), shows a cut of a similar bridge. Dr. Baker in the article referred to a number of times, says: "1-10000 in. in the size of an inlay larger than the cavity is almost fatal." In the bridges referred to, a shrinkage of 18-100 of one per cent. would put the inlay anchorages so much out of register that they would not seat properly, and possibly not even indifferently. The double compound inlay that registers a shrinkage of .0016 in.—as cited by Dr. Ward in the above quotation—would certainly not go into place unless it was forced into the cavity under a pressure sufficient actually to stretch it. This particular kind of inlay is the most difficult we have to make; and one wherein the shrinkage problem looms up most forcibly. For if the inlay is large enough to nicely sit astride the shallow central part of such a cavity without stretching, it would have to be at least as large as the cavity. If such an inlay is absolutely as large as the cavity it will not go in and seat properly for the other dimensions; and particularly so when we reckon the space necessary for the cement line. One dimension of such an inlay ought to be a trifle larger than the pattern; and the other dimension shorter. This condition we know would be impossible o obtain; and the only chance for us is to force enough stretch into it to allow it to reach over the interior of such a cavity.

We are firmly of the opinion that the investment has a very great deal to do with shrinkage, or lack of the same. An investment material should expand sufficiently on heating to follow up the expansion of the brass flask which contains it. With such an investment the shrinkage can easily be taken car of, except in large bridge castings. During the autumn of '07 your essayist conducted a more or less exhaustive series of experiments in an effort to formulate a suitable investment compound. The result of the experiments was given at a regular meeting of the Pennsylvania Association of Dental Surgeons, during the same autumn, and also in a paper read at San Francisco in June, '08:—a record of which is in the *Pacific Gazette*, Vol. XVI, p. 586. The best results we obtained were gotten in a compound made up of cast plaster 1 part, and very finely powdered silex 3 parts (by weight). In April and May, '09, we conducted a series of experiments to obtain data on shrinkage of gold castings. Castings made in Peck's investment compound showed 83-100 of one per cent shrinkage; S. S. White's showed 18-100 of one per cent, and in silex and plaster as above given, we had only 16-100 of one per cent shrinkage. These figures are for casts made in hot molds. With the same investments and technic, except that the flasks were allowed to cool to a temperature which allowed handling with the fingers, we had a loss of 1.64 per cent by shrinkage in the plaster and silex investment, and proportionately more with the other investments mentioned.

Quoting from your essayist, *Pacific Gazette,* Vol. XVI, p. 589: "A smoother casting is obtained if the investment has been allowed to remain some hours, or even days, before heat is applied." While this idea is all right for the purpose stated we find that if a flask is allowed to stand a long time before casting we have a marked increase in the shrinkage of the casting made in such a mold. We. therefore, find it advisable to choose the least evil, and cast within a few hours, at most, after investing.

We, with others, believe that the time will come when the perfection of casting devices will make possible for us to pre-determine the amount of shrinkage. Quoting Dr. Baker, *Dental Review,* Vol. XXIV, p. 130: "I believe that the time will come when we can control the size of the cast we want by the temperature of our investment. When we get this work down to a certain point we will need a thermostat to tell the temperature of our investment when we cast in order to get the size we want." Quoting your essayist, *Dental Digest,* Vol. XV, p. 499: "It yet remains for some genius to devise a form of casting apparatus with a pyrometer attachment to indicate the temperature of the flask while casting; this, in conjunction with an investment material of known physical properties could be a means of accurately determining the relative size of the casting."

We believe that a misconception is more or less generally extant in regard to why any pressure should be needed to place and hold the molten gold in the mold in casting, the commonly accepted idea being that the pressure used is needed because of air and gases within the mold. Quoting Dr. Trigger, *Dental Brief,* July, '09, p. 469: "In order to force the molten gold into such a mold already described it requires a pressure exerted on the metal in the molten state to overcome the atmospheric pressure of air within the mold; that is, the force on the gold must more than equal the air within to allow it to flow readily to all parts." According to experiments which we conducted we believe that air or gas resistance has so little to do with the need of pressure that it need not be taken into consideration. Quoting your essayist from the *Dental Digest,* Vol. XV, p. 498; "The only reason why any pressure is needed is that the molecular attraction that holds a mass of molten gold in globular or spheroidal form is greater than the force of gravity; the gold, therefore, will not by force of gravity change its spheroidal form and flow down into a mold without assistance." The experiment which proved this consisted in preparing a flask with investment material in such a manner that the sprue opening extended entirely through the bottom of the investment and flask. The flask was heated to redness—as if for casting—placed on a support so arranged that anything that wanted to go through the sprue opening would have no interference from within or underneath, and gold fused in the crucible. There was, indeed, under such conditions no air resistance from within or underneath; but gold fused in the crucible immediately over the sprue did not drop through the opening. Varying amounts of gold were tried: 2, 3½ and 5½ dwt. The first sprue opening tried was of standard size for practical work—.055, or a trifle smaller that 15 gauge. The gold was heated by the oxy-hydrogen blow-pipe until volatilization began. If the flask was raised a couple of inches and set down with a jolt the gold would then run through. The size of the sprue opening was increased by known stages until it was 120 in. (almost ⅛ of an inch) before the gold would run down of its own accord when melted—and even then only when heated to a temperature quite beyond its fusing point.

We believe that the margins of an inlay should be thoroughly burnished to the cavity margins as soon as cemented in, and before the cement has become friable. And in order that the burnishing may be effective as a means to an end, the wax pattern must have been prepared without any overlap whatever. If an overlap is present, it is the overlapping part that receives the burnishing, and which is afterward cut away in the finishing. What is then the edge of the inlay has not been affected by burnishing at all.

The cementing and finishing of an inlay should be completed at the same sitting, and before the cement has attained its utmost density. We believe that it is possible for the heat caused by the friction of grinding stones to be in some cases sufficient to cause expansion of the parts involved; the inlay having a very different coefficient of expansion from that of the cement and tooth under it may cause some areas to actually break the heterogeneous union. Before the cement has become fully hardened its physical properties would allow for this unequal expansion without risk of fracture. This is purely theoretical, having no data on the subject; but we believe that it is possible for this condition to obtain. As stated earlier in this paper, the desired specific gravity on the surface may be obtained by the generous use of engine burnishers of steel or agate, or still better, of corrugated steel.

After noting the vast differences of opinion that we have quoted and referred to, we may in our perplexity well wonder, as did Pope in his "Moral Essays"—"Who shall decide when doctors disagree?"

CAST PINS FOR CROWNS

BY W. A. STEWART, D.D.S., KANSAS CITY, MO.

This pin is to be used when and where a pin is needed in a tooth; for example, a Richmond crown, to help anchor inlays, in broken-down teeth, or to be used in root or roots of molars that are to be built up.

ADVANTAGES

1. It is tailor-made and fits.
2. No part of the tooth is taken away that it not filled by the pin.
3. It tapers, making it the shape of the root, and does not weaken the tooth at farther end of pin, leaving it plenty large enough at the other end.
4. Never fits until it is in place, leaving plenty of room for cement to be displaced.
5. The pin is made before the patient comes, and will fit as soon as it is placed in the canal.
6. Always stays in place while working around it before it is cemented.
7. Impression is not taken in wax.

DIRECTIONS TO MAKE

Fill the ring with investment and let it dry. Drill a hole with reamer in investment, then cast; drill a hole in the tooth with the same reamer, any depth desired, try pin in and see that it fits; if it is too long cut it off. I use 22k. gold.

A METHOD FOR CASTING BACKINGS FOR ALL PORCELAIN FRONTS FOR CROWNS AND BRIDGES

BY DR. D. HAIGHT, COSHOCTON, OHIO

Take any of your old cast-off facings or broken plate teeth that have no pins, of any shade that will suit the case, or a Steele facing, and grind flat like a Steele facing. Grind it on the cutting edge as sharp and thin as you can. Grind off the cutting edge to be supplied the same length you would grind the porcelain for a gold tip. Take a knife-shaped carborundum stone and cut a groove lengthwise about the depth of a Steele facing, having the walls parallel. Take inlay wax, shape it as you want your backing, and have a good tip on cutting edge, for these are the secrets of success; then remove and cast. After it is cast cut serrations in the gold lug with a knife-edge carborundum and cut little undercuts in groove. See that your facing fits perfectly to the backing. When you use for bridge or crown work, just before you invest, be sure and use antiflux so that no solder will run where your facing goes. I find Harvard cement the best for cementing the porcelain to the backing. I have had perfect success with this work for over fifteen years. By burnishing platinum on facing, the same as porcelain filling process, but since the process of casting, it is much more simple. In case of breaking one out another can be ground in without taking off the bridge.

RESTORATION OF BADLY BROKEN-DOWN ROOTS WITH ACOLITE

BY JAMES B. LESTER, D.D.S., CHRISTIANBURG, VIRGINIA

The saving of badly-decayed roots is a thing too often neglected by the dentist. I have reference to those roots where decay has progressed far beyond the cervical portion.

In my judgment the condition of these teeth arises from one of two principal causes; *first,* many persons fail to realize the importance of caring for the teeth until they are badly broken down, and then they present themselves for extraction because of alveolar abscess; *second,* many people are too miserly to have their teeth cared for until they have lost a large number, and they realize their inability to properly masticate their food.

The first class can generally be convinced of the importance of caring for their teeth. The second are easily convinced that their teeth are important to them.

In mouths of this class of patients we often find roots that are covered with gum tissue. After the decay is removed the end of the root is beyond the cervical line, hence, in my opinion, it cannot be restored with any material that is placed there in a plastic condition, because it would be impossible to make a restoration smooth and of proper contour beyond the gum line.

Because the restoration of these roots to their normal usefulness is tedious, many dentists condemn them to the forceps and replace with bridges.

In my practice, if there is two-thirds or three-fourths of a root left after the decay is removed, and that portion solid, it is worth an effort to save.

When these cases present themselves for consideration my first step is to remove all decay as nearly as possible. This will generally cause hemorrhage from the wounded gum, which is stopped. The end of the root is thoroughly dried, and the canal or canals treated with formocresol. A piece of temporary stopping of sufficient size to fill the cavity (in gum) is thoroughly softened and made into a cone, or other appropriate shape, and forced in place so as to move the gum tissue out. The patient is dismissed to return a day or two later, and at the next sitting all decay is thoroughly removed, the canal cleansed and again treated with formocresol, and the cavity packed as before. The patient is dismissed for five or six days and on returning the canals are sealed at the apex, if they are in proper condition; if not, this is done at a later sitting. The end of the root will generally be well defined, and you are now ready to begin the restoration.

If the root is an anterior one an all-porcelain crown with attached pin is selected that is long enough to allow the porcelain to extend beyond the gum margin, thus avoiding the possibility of a dark joint at the gum line. The pin is ground to proper length, and inlay wax that has sufficient rigidity to stand carving is chosen. (I personall prefer the Standard, put up by The Ransom & Randolph Co.) A sufficient quantity of this is softened and placed around the base of the pin, so as to leave an excess. While the wax is fairly soft the crown is pressed into place and held firmly until the wax is hard. Crown and wax are now removed, the wax is trimmed to the size of the root and crown, the piece is again put in place to ascertain if the adaptation is perfect. A sprue wire is attached and the case is invested as directed for casting acolite. That process I will not describe here as it would be taking unnecessary time. After casting, the metal is polished and the work tried in to ascertain if the adaptation is now perfect. If it is, the piece is set with cement, care being used to have as little excess cement as possible, as it is more or less difficult to remove excess from under the gum and any left would act as an irritant.

If the root is a molar, and you wish to use a gold shell crown as an abutment for a bridge, pins are arranged parallel to each other in the enlarged canals. A large piece of wax is softened and pressed up on pins, and allowed to harden. Wax and pins are now removed, the wax is trimmed to the size of the root as shown by the impress. If the wax does not extend sufficiently above the cervical line, more wax is softened and shaped on the end of the piece already in hand. The piece is now invested and cast. By this method we have supplied a stump to which a gold shell crown is easily adjusted.

I have suggested the use of acolite in the restoration of these roots because it can be done at a much smaller cost to the patient than would be possible if gold was used, and at the same time done well.

Where molars are too badly decayed to fill with amalgam and on account of the cost the patient cannot have gold inlays, this same method may be used to make acolite inlays that will give comfortable service.

METHODS OF CASTING IN CROWN AND BRIDGE WORK.

BY W. G. CRANDALL, D.D.S., SPENCER, IOWA.

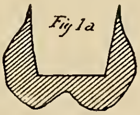
ALL CAST CROWN

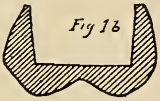
It is possible to cast an entire gold crown, and it is at times practical. It makes a piece of work that is heavy, expensive and difficult to handle.

It is always necessary to have a tooth perfectly trimmed of all enamel before starting to make a crown. It is absolutely essential that there be no overhanging wall of dentin.

If the tooth has one or more walls of dentin build it up with amalgam so that the walls slightly converge toward the occlusal. Next give the surface a finish with strips or discs. The casting wax may be applied directly over the prepared tooth if the operator is skillful enough to carve and finish while in position. This is not an easy thing to do unless the gum has previously been forced out of the way to give access for convenient finishing about the root.

The easier way is to take an impression with gutta percha, metalline, modelling compound or cement. With a burnisher work the impression material close about the root, being sure that the impression is perfect. Do not allow the impression to interfere with occlusion. When the impression material is thoroughly hardened take the bite with modelling compound or wax, bringing away the root impression in position in the bite material.





The root impression should be coated with some separating material and then filled up with cement; either build down quite long or rough so that it will be held firmly in the plaster model or insert metal pins for that purpose.

The case is now ready to place in crown articulator and pour up with plaster.

When hard, remove the bite and impression and you have an exact reproduction of the tooth, approximating teeth, occlusion and surrounding parts.

Either wet or oil the model, then proceed to melt on the casting wax a few drops at a time and carve to form. It is possible to give form to a crown in this manner that it would be very difficult or impossible to form with contouring pliers. A fit beneath the gum line may be made as perfect as that of any inlay and this is more than can be said for most gold crowns.

A most perfect fit at the gingival line may be made by cutting a seat at right angles to the long axis of the root upon the mesial and distal surfaces just beneath the free margin of the gum (*Fig. 1*) and finishing the crown flush with this line.

The possibilities of the contacts and contours are limited only by the variety of cases and the skill of the operator.

CAST CUSPS

In making cast cusps for a crown the band should be made in the usual manner, paying very little attention to contour. Take bite or impression in the usual manner and place on the articulator. A thin film of wax within the band at the gingival portion will facilitate its removal when upon the model.

The root model may be built down with plaster so as not to leave room for too great a thickness of casting wax and a subsequent thickness of gold. The wax can be melted over the surfaces of the band, giving buccal, lingual and approximal contour with precision. The occlusion can be tried and carved to an exactness.

The waxed up model of either variety of crown should be thoroughly trimmed and smoothed (gasoline or chloroform is good for this purpose) so that none of the contour need be filed or polished away.

The sprue wire should be inserted into the wax of the occlusal portion within the crown (*Fig. 2*). This is important when casting upon bands, as will be seen later.

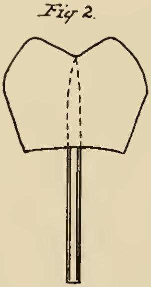


Fig. 2

In investing these crowns they should be placed as near the surface of the investment as the strength of the investment will allow. It must be remembered that the occlusal surface of most crowns is quite a large surface and there must be sufficient investment material to warrant a resistance to the molten gold when it is thrown against it. It has been my experience that a depth of from 3 to 5 m.m. should be allowed for sufficient strength.

After the investment material has become sufficiently hard (15 to 30 minutes will suffice for most investments) the sprue wire should be removed and the case inverted over a flame that will melt and burn out the casting wax. When the investment becomes red with the heat it should be inverted and heated until the investment can be seen to be at a white heat through the sprue hole. This is important, for the gold will not fuse to the band unless it is well heated.

A failure will be unknown if the case is thoroughly heated and properly cast.

If a taper-pointed sprue has been used, the crown when cast can be easily separated from the cast sprue by twisting in the fingers. A separation can be had at just the right point if care has been used in placing the sprue in the wax and an excess of wax not allowed to adhere to the sprue. Any excess remaining can easily be cut out with a bur or small stone.

A crown made after this method will need very little polishing to produce a beautiful result, providing care has been taken in every step.

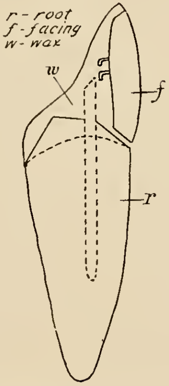
The Richmond crown is practicable upon any of the teeth that will admit of a sufficient length for the porcelain facing.

BRIDGE WORK

We will suppose that the gold crown we have just cast is for the upper left first molar, the two bicuspids are missing, the bite is very close and we want to place a Richmond crown upon the left cuspid and bridge the space.

Before making our Richmond crown we will trim the root a little different than the usual custom. The labial half of the root end is beveled beneath the gum line with a root facier and stone as for a Logan crown. The lingual half of root end will not be beveled nor cut down to the gum line, but will be cut flat, making a good seat for the crown. The enamel should now be thoroughly removed from the root (*Fig. 3*).

Fig. 3



An iridio-platinum wire about 16 gauge is fitted to the canal and left protruding from the root end about 2 m.m A suitable facing is ground to position, allowing room for a gold tip for the protection of the facing. The pins should be bent so as not to interfere with occlusion or the contour of the crown.

A piece of casting wax of sufficient size should now be softened, or better, melted, upon the back of the facing, approximately the shape of a crown, and the root pin inserted. This, while soft, should be forced upon the root, the facing adjusted to the desired position and occlusion carefully noted. The wax should be tightly burnished about the root with cold burnisher. After thorough adjustment, chill and remove for careful trimming. Casting wax that is sufficiently hard to admit of handling and trying in the mouth without danger of changing form, should be used. When the desired form is secured and the wax smoothed the sprue wire should be inserted in the wax upon the lingual surface of the crown at right angles to the back of the facing.

Great care should be taken that no wax extends over the labial, mesial or distal surface of the facing as this would be liable to cause a check in casting.

This arrangement places the facing in position to receive the most possible heat in the investment. The investment should be made the same as for the gold crown, the wax melted out, the case inverted and heated slowly at first, gradually increasing the heat to the extreme, so that when the hot gold is cast upon the facing there will not be enough difference in temperature to cause sufficient expansion to check the facing.

The moment the cast is made and the gold has hardened the case should be covered with dry plaster and left until thoroughly cool. Most of the failures in casting onto facings have been due to rapid cooling. Powdered plaster will keep the case warm for about a half hour or more, and it is time saved to leave it plenty long enough.

A crown made carefully after this method should go to place on the root as perfectly as any inlay, and if properly finished should never become an irritant to the gum tissue.

To complete our bridge we will place the crowns in position and take accurate bite and impression. This is easily done with plaster on the Detroit bite impression tray, bringing the crowns away in position and allowing no chance for change of bite.

The inside of the crowns should be coated with a thin film of wax and the case mounted in plaster on the articulator. Separate and warm crowns sufficiently to melt wax and thoroughly clean out all wax so that crowns rest perfectly in position.

Bicuspid facings are now ground and fitted, casting wax applied to them, and while warm they are placed in position and the articulator closed and worked about as in chewing. Now carve cusps and trim wax as you want the bridge when finished. Use great care that wax does not overlap the facings in any position. It should cover the same portion of the facing as you would include in backing a tooth for soldering. The case should be invested and cast the same as the cuspid crown. It is now ready for assembling. This is not done in any way different from the ordinary procedure, with the exception that very little solder is necessary.

This makes a bridge that is nearly perfect hygienically. There is no space between the facing and gold as with ordinary backing, there are no solder pits to cause trouble in finishing. The crowns fit like inlays, allowing a minimum of cement which we all know is the foulest of substances when removed from an old crown.

The color of the gold should be uniform, the same kind of gold being used throughout.

In casting anterior cases where it is desirable to have the case thin linguo labially, I would suggest clasp metal. Though difficult to melt sufficiently to cast, it gives the maximum of strength and rigidity for its bulk.

If it is desirable to have the facings removable, the backs of the facings should be oiled and the pins left straight. After the waxing up has been completed, remove facings and place sharpened pencil points in the pin holes, having the points long enough for the investment to hold in position for casting. Facings can be easily adjusted and cemented to position after bridge is completed.

Another good method for making facings removable and a strong attachment when in position, is by bending the pins down on the facing so they lap, and as close together as possible. Then cover with soft solder or some of the easily fusible metals. Grind this into a box form just so that it can be withdrawn from wax without pulling. This makes a very strong attachment and is easily and quickly made.

CAST ANTERIOR BRIDGE ABUTMENTS AND VARIATIONS OF THE SAME FOR PERMANENT SPLINTING OF LOOSE TEETH.

BY GEORGE C. MCCANN, D.D.S., DANVILLE, ILL.

Doctor McCann's table clinic demonstrated the technic and use of two anterior bridge abutments—one consisting of a root canal dowel, with lingual and proximal gold backing attached. The enamel of the tooth (preferably six anterior) is ground so as to accommodate the occlusion with sufficient thickness of gold. The margins of the backing is carried to self-cleansing areas. The other consisted of an anterior attachment for a live tooth (preferably bicuspid). Trimming the lingual, occlusal and proximal surfaces to accommodate thickness of gold and to self-cleansing areas. A groove is then produced with a millimeter cross-cut fissure bur over the proximal and occlusal surfaces.

Splints for loose anterior teeth were modifications of the abutments. For the lower anterior, axial directed pits 1.5 to 2 m.m. in depth were made on the lingual. Into the pits stub pins were placed and a casting made supporting pins and furnishing a solid lingual backing to the teeth; a splint was then soldered to either form of bridge abutments placed on sound teeth.

A posterior splint consisted of a wire placed in an occlusal groove cf loose teeth and supported by inlays located in sound abutting teeth at each end.

The purpose of the clinic was to present strong esthetic abutment of anterior work by confining the case to the lingual aspect.

AN IDEAL BICUSPID OR MOLAR CROWN

BY GEORGE S. SCHLEGEL, D.D.S., READING, PA.

An ideal artificial crown is one that possesses all the qualifications of its natural predecessor. In fact, the artificial substitute cannot decay, can be easily repaired if broken, and very often makes a better appearance than the natural tooth, when the latter is affected with atrophy of the enamel, discolorations, and partial fractures. In order that I be not misunderstood, I wish to inform my readers that a tooth should not be crowned unless it cannot possibly be repaired with some permanent filling material suited to the class and position of cavity or cavities.

The crown I wish to describe is made possible by the application of the principle of casting gold under pressure. The method can be used for any tooth in the mouth, but is especially adapted for biscuspids and molars. No ethical dentist should place a gold crown on the oral teeth, but biscuspids and molars are crowned by them, with the hollow shell crown, because the repertoire of crowns used to date lacked one that possessed both the necessary strength and esthetic qualities. I will point out the value of this crown by comparison with others now commonly used at the conclusion of this article.

In order to give you a clear conception of this method, I will describe how to make a superior first biscuspid crown:

The proper preparation of the root is essential for the proper adaptation of the crown as for any other crown. The root should be filled with red gutta-percha points, which serve as a guide in reaming the root canals, the little red spot indicating the direction of the root. The diameter of the canals should be enlarged in proportion to the diameter of the root. I use No. 16 to 20 gauge iridio-platinum wire in the roots.

The next step is to cut down the root flush with the gum line. Then bevel root on the buccal side and palatal side to about one m.m. below the free margin of the gum. Take a No. 5 or 6 bur to countersink opening to the reamed root canal to the depth of 1½ m.m. I insert iridio-platinum wire into each canal, cut flush with surface of root, and remove to bracket table for future use. This completes the root preparation.

The next step is the selection of a porcelain detachable crown of any make desired, but of such size and color as will conform to the case. If necessary to grind to occlusion, grind the occlusal surface; the reasons for this I will point out later.

Now take a piece of black inlay wax of a rather stiff quality, like S. S. White's, and after lubricating the inside of the opening of the artificial crown with a little sweet oil or glycerin, press the wax, which was previously warmed, into the opening of the tooth. Withdraw to see if the undercuts in the tooth interfere with proper removal, and if they do, correct the fault. Return wax to crown, and trim approximately. Warm slightly and press crown with wax to the root. Note the condition of occlusion in arch, etc., then chill with iced water and remove. Note the opening to the canals by the elevation in the wax. Heat the iridio-platinum pins previously fitted in the roots, and place in approximal position in wax. Return to root for final adjustment. Be sure that all the wax is hidden beneath the gum. Chill again, remove carefully from root, then remove wax from the crown. Carefully insert a sprue wire at the end of the wax with pins, which touches the remotest part of the opening in the artificial crown. Invest and cast according to any of the methods used in casting gold inlays. Cement crown on cast base, and then cement the crown and base to place.

This gives you a crown that is perfectly adapted, esthetic, durable and easy to repair. The reason for grinding the occlusal surface is obvious from the fact that repairs would be easier if a record is kept of the number of the mold used, then a tooth of the same mold will fit the case without any grinding at the gum line.

It is my firm conviction, gained from actual experience with the insertion of these crowns for a period of over a year, that they are ideal. They are better than a gold crown for esthetic reasons. Better than a Richmond crown because in this ideal crown no band is needed, for bands are an abomination at best, and unless a Steele's Detachable Facing is used, the color is often far from satisfactory. Again gold tips are unsightly. Better than a Logan crown because it is very often difficult to adapt to the root. Again, the leverage on the pins is very great, and often ends in the splitting of the roots. Better than a porcelain or platinum jacket crown, because either is liable to fracture, and difficult to repair.

CAST ABUTMENTS FOR THE ATTACHMENT OF BRIDGES

BY W. M. MCCALL, D.D.S., LOUISVILLE, KY.

Cast abutments for the attachment of bridges, using in this case, superior left cuspid to first molar.

Prepare the cuspid, first by removing with the stone sufficient amount of tooth structure from lingual portion of tooth to give room for construction of inlay. Grind two small grooves across lingual surface, then with small round bur make three openings, two towards incisal, one towards gingival. In grooves which were made in tooth, fit number twenty (20) platinum wire and proceed to construct the inlay in the usual manner.

To prepare the molar tooth, grind off occlusal surface, starting at lingual and gradually tapering towards buccal surface. Then cut cavity in mesial portions, extending under free margin of gum, and from lingual to buccal of mesial surface, placing in the occlusal two or three number twenty (20) platinum pins, so as not to come in contact with the pulp of tooth. Proceed to construct inlay in the usual manner. Place inlays in position, take bite and impression, using for dummies Brewster's diatoric teeth. Grind up dummies, swage backing and solder as in ordinary piece of bridge work. A bridge properly constructed and attached by this method is very strong and durable. The main feature is that no gold shows on labial and buccal surfaces.

THE SCOPE OF CASTING IN DENTISTRY.

BY R. C. BROPHY, M.D., D.D.S., CHICAGO, ILL.

While casting metals in dentistry is by no means of strictly modern origin, it is only of late, or following the application of the principle to operative work, that it has come to be regarded with particular interest by the profession. It is doubtful, however, if, with all the interest shown at the present time, the complete scope of the work, or full field in which it is applicable, is properly appreciated.

It is not the purpose of the writer to dwell upon the casting of inlays proper, as substitutes for fillings, for that subject is being widely discussed, and is quite well understood; but I would, taking that as a starting point in consideration of my subject, follow along further and take up other things in the same field.

I have always felt that there are possibilities in the process of casting in dentistry of really greater value and importance than the casting of inlays to fill cavities in the crowns of teeth.

Making use of inlays is dependent upon the extent to which destruction of the crown of a tooth has been allowed to proceed; their applicability must be measured by the proportion of the crown remaining; there must be a given area of sound, solid tooth structure to support them. Many cases present where there is not such sufficient sound structure, and it is in such instances, in the writer's opinion, that there lies the greater possibilities of valuable accomplishments through the casting process.

It is a pity that teeth are allowed to pass beyond the pale of repair by simply plugging cavities; but the time will never come when the dentist will not meet conditions either presaging the complete loss of the tooth, or, exacting extreme ingenuity and skill in its saving. It is not so much a question as to whether the dental profession could keep everybody's teeth in normal condition, and intact, as it is a fact that it never will have an opportunity to do anything of the kind. People sometimes neglect to lock the barn door until after the horse is stolen. A great many people never entertain a thought of consulting the dentist until their teeth are so extensively involved in destruction that artificial restitution is demanded.

Then, again, the matter of casting inlays proper applies only to those cases where restoration of a tooth may be accomplished by old, ordinary methods of operative procedure. I want to connect the casting process with those cases which no dentist would think for a moment of attempting to restore by operative procedure, those cases in which the little remaining structure, merely the shell of a root, though it be, are made use of as an abutment or anchorage for a cast restoration, or the mounting thereon of a porcelain crown.

It is scarcely possible to conceive of a tooth assuming a condition of decay, which, from a mechanical standpoint, cannot be restored, if the casting process be employed, waiving, however, discussion of the many things that may be done in the way of restoration of the crown of a tooth where the root is sound and solid. I would speak particularly of that procedure which I believe constitutes the most valuable and important achievement possible in casting. I refer to the mounting of crowns upon badly-decayed roots where, possibly, but a shell remains, and this shell buried beneath the margin of the gum.

The method of making such a restoration is so simple that it can but appeal to all. If the shell upon which it is desired to mount a crown be deep down underneath the gum, it will be found that gum tissue has covered, and likely, partially filled it, and in that case this tissue must be crowded back by packing. The root should then be cleaned of all debris and its edges trimmed to a solid margin.

If the restoration is to be made of gold, a detachable pin crown should be used, the dowel, or pin, with the crown in position upon it, should be invested with softened inlay wax and should be crowded down into the root, the latter having first been moistened with saliva. This procedure should give a perfect model of the canal, or shell, and a perfect mold of the base of the porcelain crown. The crown may now be taken off the dowel, and the latter, with the wax model attached to it, may be lifted out, trimmed, reset, removed again and retrimmed, until finally the wax is found to be perfectly adapted. The crown should then be removed, the sprue wire attached, and the case is ready for investing and casting.

If, instead of making the restoration with gold, Acolite be used —and for these cases the writer does not hesitate to say that he regards Acolite perferable to gold—the cast may be made direct to the porcelain, or not, as is desired, and ordinary vulcanite plate teeth and German silver dowels may be used instead of special crowns with their dowels. After the restoration is finished it may be set with cement, and if the crown used be detachable, it may then be cemented in position on the dowel.

The casting process in relation to bridge work is an important consideration, but one upon which I realize that I have peculiar views. I believe that if porcelain teeth of a detachable or removable character are made use of, and as a matter of fact they may be, that casting bridges is practical; but I am led to believe that unless the bridge be cast along that line that it better not be cast at all.

I have long felt that casting gold to porcelain is too uncertain and questionable to be practicable or advisable. It is true, of course, that a piece of porcelain will now and then be found to have withstood the shock and the effects of the natural changes of the gold, after the two have come in contact, but I know that such occurrences are very rare. In a very great many instances the porcelain plainly shows checks. In very many instances the porcelain appears to the naked eye to be uninjured, but my experience has shown that in almost all cases examination under a magnifying glass will reveal checks. These checks, of course, weaken the porcelain and make it unreliable and unworthy of dependence. I regard the casting or gold to porcelain as impracticable.

What I have said in relation to casting Acolite in crown work applies to bridge work. Acolite, owing to its low fusing point and its non-changing qualities in congealing, may be cast to porcelain without danger of checking it.

Casting metal plates in dentistry has been done in our own country for fifty years, and a study of the subject from a standpoint of evolution is interesting. Dr. James B. Bean, who was the first dentist to experiment in the work, undoubtedly was actuated in so doing by a desire to make use of the then practically new metal—aluminum—for base plates. It is doubtful if the metal was procurable at that time in sheet form for swaging. Dr. Bean attempted to make use of straight aluminum without trying to affect any change in it by alloying. When we realize that pure aluminum is not produced at the present time, we may imagine the purity of the metal he used at that early time, and, knowing what we do of the effects produced by certain oral secretions upon the "pure" aluminum with which we are now supplied, we may further imagine the troubles which confronted him in practice. It is quite likely, also, that Dr. Bean had his troubles in making perfect casts, for he depended upon gravity to inject the metal into the matrix, or mold.

Following Dr. Bean, other men became interested in casting aluminum plates, notably Dr. Carroll and Dr. Zeller, but without commenting upon their experiences I will consider the matter from a present-day status, and purely from a mechanical standpoint, in conformity to the title of my paper.

It may be interesting to some to know that as long as fifteen years ago the writer, as well as other dentists, made use of the identical principle in casting plates that is being employed by many at the present time, in so-called inlay casting; viz., burying the model, using a crucible former and sprues, burning out the wax and forcing the metal down into the matrix with air pressure.

The casting of plates is an extremely important phase of dental casting, and is found at the present time to be following very closely the wonderful development and gain in popularity of other forms of dental casting. While I do not deem it advisable to make a practice of casting large full base plates in gold, there are cases where delicate horseshoe or saddle plates may be cast in this metal to advantage.

Casting in dentistry has a practically unrestricted scope, and its value to the profession and to humanity cannot be computed.

A SIMPLE METHOD OF CASTING PIN AND COPING FOR A PORCELAIN CROWN

BY DR. PAUL J. BOYENS, WEED, CALIFORNIA

Select a detached post crown to fit the case and fit it to the root in the usual manner. Ream the canal with a gradual taper, making the orifice a trifle larger than for the ordinary post. This increase in the size of the cast post at the point of greatest strain will more than compensate for the difference in strength between the cast material and a platinum or iridio-platinum post. Warm a small piece of inlay wax and roll it into a stick that will approximately fit the canal, leaving it a little long. Lubricate the canal, and while the wax is still slightly plastic, work it gradually into the canal. Soften the projecting end with a few blasts of warm air and warm the crown and press it firmly into place. The wax squeezing out all around will indicate that an accurate impression of the root has been secured. Chill the wax thoroughly and withdraw, then with a sharp knife trim off the surplus. Invest in soft material with the crown downward, the wax post serving as a sprue through which to cast the gold. Cast in the usual manner, using 22k. solder or platinized plate gold. Let the flask cool thoroughly before opening. Various modifications of this method can be made. A plate or a vulcanite tooth may be used, in which case it is advisable to leave the lingual side of the root a little longer.—*Dental Brief.*

METHOD OF PRODUCING PERFECT MARGINS

BY DR. C. KABELL, CHICAGO, ILL.

The practical value of the cast filling, its ease of manipulation to the patient, and its time-saving advantages are appealing to me as to everyone, and I employ it wherever it shows a saving of time compared with the malleted filling, but I have been forced to change my technic.

Instead of carefully trimming down all overhanging edges I leave a little surplus over all margins and after setting and allowing the cement to harden fifteen to thirty minutes, trim down the edges with gold finishing burs and repeated burnishings.

In doing this, care must always be taken that the tool rotates from gold to margin. For example, if I finish an occlusal filling in a right lower molar I trim the labial margin by running the engine the regulation way, from left to right, but reverse the motion when working on the lingual margin and do not forget to lubricate burs and burnishers with vaseline.

By these means I have succeeded in closing the margins perfectly as far as can be determined by occular and exploratory inspection.

This sealing of margins is necessary in the light of our past experience with cements of the consistency used in setting of inlays, which is the same as has been employed for a few decades for setting crowns and bridge work.

I have removed very few crowns, etc., that did not greet me with that foul odor that cement stores up in its pores, and I have more often than not seen decay recurring under even well-mixed cement fillings.

The thinner the cement the more easily it is washed out and cracks form that invite decay.

In cases where the shrinkage and warping of the filling would be too great to overcome by burnishing, I employ a different technic.

The gingival margin has always been the weakest part of a filling, showing the greatest percentage of recurrence of decay, and it is also the vulnerable point of inlays. As it is in most cases impossible to properly burnish gold to place between the teeth, I help myself by beveling, giving the edge an angle of about 120 degrees.

The corresponding gingival margin of the inlay will show a V-shaped form, the outer edge of which I burnish inward and depend on the malleting to open it sufficiently to make it fit snugly. If, upon examination, I find any opening, I repeat, and only after being certain of a perfect fit will I cement filling into place.—*Items of Interest.*

THE CAST CLASP.

BY W. B. CALDWELL, D.D.S., HAMILTON, OHIO.

The cast clasp is the most accurate clasp that can be made. After securing a perfect cast from a plaster impression, proceed to burnish No. 40 tin around the teeth to be clasped, which will keep the wax from adhering to plaster tooth, then take inlay wax and press around the tooth, carve to the desired shape, then attach a small piece of wax for a lug, remove, place on sprue wire, and invest; use regular clasp metal for casting. Cement clasps on case before setting up the teeth, to hold them in position.

By using this method you will have a denture that, when inserted, will give a very pleasing result. It will not spring, but will be absolutely firm.

NUGGETS OF GOLD—INLAYS

BY O. E. LANPHEAR, D.D.S., PAW PAW, MICH.

The dental art requires painstaking study and careful manipulation to obtain ideal results in gold inlays. Trained discretion in the preservation of tooth substance is as great an aid to permanency as extension for prevention or retention.

In simple cavities the seat of the cavity should be flat and parallel to the plane of the defective surface, while the walls should be nearly at right angles to this and slightly divergent. In compound cavities, lateral retention is secured by frictional planes, dovetail extension or pin projection, that will allow the model to be removed without distortion. Any deviation from the desired planes, as pits, under-cuts and spherical depressions, should be filled to within one millimeter of the surface with good cement, and carefully trimmed to allow of drawing. When this has set the cavity is moistened and the apex of a warm wax cone is placed against the deepest portion of the cavity and the remainder is pressed to place with the fingers.

In compound proximal cavities, a strip of linen, celluloid or dam should be drawn tight at the gingival border, for it greatly facilitates the work, especially in cases extending below the gingival line. It forces the wax tightly against the cavity walls and gives an approximate contour to a border which demands perfect carving.

The wax should be chilled and the excess removed with a sharp carver, leaving the occlusal full; now heat this surface a little and ask the patient to bite. He is then left to his own devices for a moment to allow him to give it a natural bite. When the wax is chilled again and the articulation is accentuated by carving, the approximal surface is given a full contour and a normal contact. Polish the surface of the wax and remove cautiously with a firm point and a steady hand. Give the model a critical examination and do not hesitate to return it to the cavity if there is any possibility of distortion. If assured that the wax is a perfect prototype of the filling, insert a heated sprue pin in the axial plane of a convex surface. This will aid the gold to go directly to its destination *without marring the investment margins*. See that no pits remain at the union of the pin and the model. Place the bare end of the sprue pin in the crucible former in a position that will bring the wax near the bottom of the investment ring. Coat the wax with alcohol and immediately proceed to apply a thin mixture of the investment with a camel's hair brush, forcing the investment along under the film of alcohol, thus excluding the air. *Gradually force this layer off with a thick mix* of the *investment*, filling the ring with the same and bring the model to its position in the ring. In five minutes, when the investment has set enough to be firm, the sprue pin can be heated a little to soften the wax, and removed with the crucible former on it. Now invert the case and place on the heater, where it is slowly brought to the boiling point of the wax (75° C.), when the wax comes out. From this point, the heat may be carried up rapidly and some of the carbon burned out. *Do not carry the heat higher than necessary,* as it has a tendency to distort the space left by the vanished prototype. A liberal piece of gold is now placed in the crucible formed in the investment, heated nearly to the boiling point; when the force of the machine is applied it rushes down the sprue hole, forcing the air through the thin and porous investment, filling the space left by the wax and remaining there under the pressure of the machine until congealed, when it can be cooled rapidly in water. The inlay may be pickled to remove the investment material, the excess of gold cut away on the lathe and the surface given the desired polish. Then try it in the cavity. Make sure of the borders and the little details which insure the permanency of the inlay. When satisfied with the trial, remove the inlay and cement to place with a rocking hand motion, aided by the mallet in most cases. The cavity form must furnish the retention, leaving the cement to hold the inlay in position and give thermal immunity. The margin of the tooth should be cut true and as nearly at right angles to the surface penetrated as the structure of the tooth and the cavity outline will permit, then *the inlay will butt the cavity margin,* forming an ideal joint. This joint should be absolutely flush and well burnished. The margins of inlays should be accessible for convenience in working. Sharp angles at the cervico-buccal and lingual aspects of the approximo-occlusal fillings should be avoided. In occlusal cavities, the outline of the cavity should have rounded angles, to avoid the gold wearing away the corners in the investment at the time of casting. The cavities with narrow necks are apt to show that parts of the investment have been worn away leaving the inlay full at this point. It will not go to place until the neck is narrowed at these points.

Let us bear in mind that while we have mentioned many of the salient points in the technology of the cast gold inlay, which saves frail teeth and weak enamel walls, relieves patients of many of the nerve-racking procedures incident to the placing of the rubber dam, the condensation of foil and the tedious sitting, it alone does not constitute professional success. The profession of skill, brilliancy, honor, social position or the ability to get the nuggets of gold, do not spell success. It is the frankness of expression, largeness of heart, flexibility of mind, accurate perception of difficulties and true discrimination, that makes our continued, conscientious services benefactions of the race, and bring to us the appellation—Success.

LIMITATIONS AND USES OF THE GOLD INLAY

BY H. M. SEAMANS, A.M., D.D.S., COLUMBUS, OHIO

We have passed the experimental stage so far as the uses of the gold inlay are concerned, and its limitations are controlled only by any other time-proven filling material that will suit, in the judgment of the operator, the necessities of the case.

This subject does not exact from me arguments against the use of gold inlays; rather I am expected to observe their already proven use while I try to show why and how and where their use is called for in filling tooth cavities. Please keep in mind that the older inlay, porcelain, at the hands of skillful operators, has established itself not only as our ideal esthetic filling material, but that it is recognized as a most excellent permanent stopper, for thousands of such inlays are holding forth without carious returns about their environments. Also keep in mind that many more thousand gold fillings are still today showing to us that they are capable of perfect sealment of the cavities they occupy. And there are none of us but will give thanks to the persistent efforts of those few enthusiasts fifty years ago who by such efforts gave us amalgam, up to the present time our greatest posterior tooth preserver. Only a few years ago we had no other thought than that these two, gold and amalgam, placed properly against tooth walls, were par excellent, without limitation in the proper use of each in its place; in fact, nothing else was used except gutta percha and cement. But hold! like the crusaders of old I have found the talisman! Cement, oxyphosphate of zinc, once a temporary make-shift for frail teeth, cheap fillings, nervous, sickly patients, stopper of dressings, scorned by all as a permanent filling material, except by the occasional few who recognized an esthetic worth to it, even though constantly replaced.

It is hard to tell whether it was the solid block inlay idea of itself, or else something to help cement to be retained in a cavity, that has brought about inlaying of cavities; probably the groping about and working out of both ideas. However, today we accept the fact that inlays without oxyphosphate of zinc are as impossible as moon beams at high noon.

First, then, where are gold inlays uncalled for? In all cavities unlined with oxyphosphate of zinc. We all know that, only let us always keep it in mind. Next, in all the six anterior teeth which will warrant porcelain inlays, chemical porcelain cement, and gold fillings. We are now occasionally hearing the remark that porcelain inlaying has had its day. Yes, some kinds of porcelain inlaying has had its day, and most of us, no doubt, have helped some of our own and others' porcelain inlays to have their day, with a sigh and a-lack-a-day. But porcelain inlaying has improved so greatly, and bad results have taught us so thoroughly, that we know anterior tooth cavities which allow good thick edge approach of the inlay, where necessary, can be, and are, effectively and beautifully filled with baked porcelain. Chemical porcelain cements, while yet in an experimental stage, are showing, under wise and careful selection of the place, some very good results. All small cavities in anterior teeth which are not conspicuous and in many cases large proximal cavities which are more or less inconspicuous, do not call for the gold inlay. It is still good practice to fill such cavities with gold in the good old-fashioned way. The wide wedging and broad cutting away of tooth structure for inlays is not warranted. It would seem then, that I have very nearly eliminated the gold inlay for the six anterior teeth; especially for esthetic reasons, they should not be used, if possible to avoid doing so. Yet under certain conditions a thin frail tooth, not having a great amount of labial surface involved might warrant a gold inlay, with iridio-platinum pin and proper lingual preparation brace against stress and strain. We all see mouths with teeth more or less shortened, incisive ends badly worn down, the dentin between the enamel layers of hard to soft decay always connecting up with proximal cavities or leaking fillings; gold inlays indicated there? Yes, many times. Yet, ideally, what about the jacket porcelain crown?

The gold inlay with porcelain, baked or inlaid into it, as advocated lately, may work out to be a most excellent combination for anterior and some posterior restorations; if so, then to that extent do we remove a limitation.

Posteriorly, gold inlays are almost unlimited. The cost of a filling of course is a tremendous factor in our work, so I must immediately qualify that statement. Amalgam can be so quickly inlaid in almost all posterior cavities, and made very effective, so that it removes the necessity of gold alone as a posterior inlay. But we must remember that it is amalgam's cheapness over gold that gives it its great advantage. Laying aside wax fillings for leisure hour casting, or laboratory assistant casting, and the use of impression material with Price's stone cement models for subsequent filling and casting, has given us great conservation of time. The ease with which amalgam is manipulated as against the labor and time taken to mallet in a posterior gold filling has cost almost all users of amalgam enough money to have bought and almost maintained that coveted automobile, or given an occasional trip abroad. In the minds of many dentists, gold malleted fillings used in the posterior teeth have become ancient history. Yet the gold filling can still and should be still used in most of the pit and fissure cavities. On the other hand, we can average up better contour and contact points with the gold inlay; our grooves, cusps, fossæ and ridges can be perfect reproductions; the restoration of all frail and extensively-decayed teeth is now almost universal; while as for ease and comfort to both patient and operator, there is no comparison. Gold inlaying, then, in posterior teeth, has wonderfully enlarged our field for better restoration.

We are constantly being told today that there is but one thing that stands in the way of inlays as our ideal fillings, and that is the always possible dissolution of the cement. This objection can be overcome in several ways. *First,* prepare the cavities right and obtain a correct inlay; *second,* set the inlay as Dr. Taggart tells us, with first a rocking motion so as to flow or rock out all the cement possible, followed immediately with firm, steady pressure for twenty or more minutes. A good inlay in a properly-prepared cavity should almost, if not quite, eliminate the edge difficulty. But if it does not, and it often does not, then finishing bur burnishers will spin the gold over the margins. Lately we have been told that it is well to trumpet or bevel out more than we used to do, and this seems to be good advice. Our gold will burnish out or spin out under the dull bladed burs, polishing to a smooth nicety with disks and strips as of old. Also we have lately been advised against the removal of quantities of our gold, either to economize or to give place for cement to get into to help hold, following the line of argument that the closer our inlay walls approximate the cavity walls, and the less cement we retain, the greater is the power of resistance; and that sounds like most excellent advice and a scientific truth, for small and medium sized inlays at least.

Pure gold seems to prove itself by all odds our best material, with 22k. plate a second choice. Pure gold has proven itself to be much stronger and better able to withstand stress and strain than was expected of it.

Dr. Price's use of stone cement models to cast into has given us a splendid way to obtain perfect proximo-cervical enamel edge adaptations, and very much of the trimming can be done before placing in the tooth.

We are all quite familiar with the lamentations from some dentists over the fear that operators would soon lose their skill and cunning because of the fact that there will be much abandonment of gold fillings in favor of the inlay. Feared as much myself. But while delving lately into some old magazines, I was very much entertained over the fears of the old regulars that the new fandangled material, cohesive gold ("works just like putty"), as against the continued use of gold foil (non-cohesive) would entirely eliminate skilfulness and manipulative ability from the dental profession. No, indeed, it is going to take great skill and manipulative ability to place a perfect gold inlay, one that retains its seat immovably before cementing, except in the direction of its desired withdrawal, one that closes of itself the margins, one that will conserve the tooth for years, one that will restore the contact point so splendidly that there will be no "meat spaces" with the terrible concurring ailments of gum and alveolar tissue, one that will present perfect anatomical restorations of all its surfaces, one that will protect enamel walls from fracture, in fact, one that will do that which we most desire, save the tooth in an ideally practical manner.

CROWN AND BRIDGE WORK

BY J. H. LANDRY, D.D.S., NEW ORLEANS, LA.

I have kept in touch with the best methods of crown and bridge work for twenty years and can enter with perfect propriety upon a discussion of the exercise of prudence in the application of the principles of crown work and bridging of spaces.

I do not propose to criticise or pass judgment upon methods that are freely used by others.

The very minutest detail of mechanical construction will not be given, feeling such to be unnecessary; and I will deal with the broad underlying principles that govern the attachment of a foreign substance to a root in the mouth as a substitute for the lost crown, and the attachment of one tooth to another to support substitutes for the missing ones, calling upon them to perform duties belonging to the full membrane.

The experience and success of so many years has given this class of work the acknowledged right to be considered among the most useful and reputable operations of today; but the question arises, what has been the effect of its introduction to the dental profession for good or evil? Like most all advanced methods, its benefits up to the present time have been in restoring and preserving roots and broken down crowns of teeth that would otherwise have been lost, thereby improving the power of mastication, prolonging life and health.

How many times has there been a loss of good roots and teeth through improper attachment for the purpose of withstanding a strain they were unable to bear, by injudicious fit—or badly-fitting bands, causing irritation of the peridental membrane?

A perfect crown must provide:

Firstly: A natural appearance if for the anterior teeth.

Secondly: A Richmond or preferably a crescent band to guard against splitting weak roots.

Thirdly: The fit should be perfect so there can be no dislodgment.

Fourthly: To preserve the interproximate spaces and guard against all irritation.

Bridge work embodies all the foregoing dangers, increased proportionately to the greater strain it is called upon to bear.

The collection of particles of food or other decomposable matter between the ridge or under the gum may be avoided by making the surfaces and interspaces self-cleansing.

The Logan, Bonwill, Howe, Davis, White and all other porcelain crowns that are used have certainly the advantage of a more natural appearance for the anterior teeth, over a plate tooth backed by metal. Of the ready-made crown I consider the Logan less desirable owing to the shape, size and weakness of its pin, which has been the cause of many split roots.

Noting the value placed upon a band for the security of the crown to root for so many years, is gradually passing to a crescent or no band at all because we hear on all sides, "keep the neck of the teeth free from deposit of calculus or anything that might irritate the gums," and in the same breath we are told to "pass the bands up well under the free margin of the gum, regardless of such irritation."

Dr. E. Palmy Brown was the one who brought before the profession the system of porcelain bridges, anchored with gold fillings, malleted about a bar extending into the tooth.

Now the dental profession is greatly indebted to Dr. Taggart for his methods of casting gold inlays and for the attachment of crowns and bridges that will save the necessity of sacrificing the whole structure of many good teeth for bridging.

I very seldom use a band any more; it is unsightly, unnecessary, and with a good pin you will get all the strength wanted, as all the force is outward. Sometimes a band is necessary in a lower tooth where recession of the gums has left space for a very short pin to be used and a good sized band can be used and not be seen.

In preparing roots for crowns I always seal the apex before reaming canal for the reception of a pin, and thereby avoid much future trouble.

The dowel should be made of platinum and iridium wire only; all other kinds are unsafe if subjected to much heat.

Before crowning a tooth always devitalize. Should pyorrhea alveolaris develop after a few years in that mouth, those teeth will be free from the disease while one sound one after another will be lost unless they are carefully treated.

I never take an impression for crowning of the anterior teeth; my patients' mouths are my true models, and besides save lots of time. Get size and shade of facing ready before the appointed time of patient.

After reducing the root to the desired shape, take No. 33 gauge pure gold and burnish to the root, leaving it a little overlapping in lingual portion to burnish over root that will take the shape of a crescent band. Should you desire a large crescent band, fit one and solder to pure gold before burnishing same over root, then punch hole through plate and push pin to place, remove and solder (the pin having been previously closely fitted to the canal), replace same on root, reburnish to water tight joint and then trim to fit periphery of root. Grind facing to fit, back it up with No. 33 gauge gold, wax and attach the cap in mouth, remove crown, finish waxing as you want it, box cutting edge and sides, invest and solder. When polished you have a crown which fits perfectly over entire root and in cementing to place a thin film of cement will be caught between the attachment but not enough to weaken the strength of your crown. An open-faced crown is not a good anchorage for a bridge, for the attachment to be any way weak will cause a failure.

It is almost impossible to lay down any set rules to follow, but I will mention a few cases where a bridge will do good service. In making a bridge of twelve or fourteen teeth it is necessary to have not less than four good teeth or roots, including the two cuspids and two solidly set molars, that will carry a bridge for good service. In this case the cuspids should be cut off and crescent crowns used, the molars should be devitalized and two gold caps made for the abutment.

In case where right central and lateral are missing, left lateral and first and second bicuspid out, I would make that bridge in two pieces by using right cuspid and left central to carry right central and lateral, left cuspid and first molar to carry two left bicuspids and lateral. In all cases a good bridge can be made from a cuspid to a third molar. The two centrals will carry the two laterals and the laterals the two centrals, and so on. A loose root, if properly treated, will get firm and strong again.

I will now touch lightly upon an important part to consider. In trimming molar teeth you should always have in mind what the shape of the tooth would be if cut across below the margin of the gum, the barrel shape entirely taken off to nearly one-sixteenth of an inch below the gum line, leaving the sides of the tooth parallel so that the band will hug the tooth tightly. Take a lower first molar. The buccal side swells out very greatly but the anterior surface not so much. After this tooth has been properly shaped it will be nearly square, with the corners rounded.

In many cases after trimming the mesial and distal surfaces it will be necessary to trim only the lingual side; as the tooth often leans over towards the tongue, the band will pass over the enamel on buccal side and touch the tooth below gum margin.

The most difficult part to reach in trimming is the anterior surface of the lower molar. If you will take notice, an upper molar, when triangular in shape. This will sometimes vary, the palatal root being as broad as the two buccal roots, but not very often. A great deal must be cut from the mesial and distal surfaces of the posterior teeth and very little from the buccal and palatal or lingual sides. The cusps should be ground away, so a thick metal cusp can be placed on the band to insure a strong bridge.

CASTING GOLD ON PORCELAIN

BY E. CUNNINGHAM, PERRY SOUND, CAN.

At last I have been successful in casting against porcelain without checking. I use a flask, the dimensions of which are one and one-quarter inches in diameter and the same height. After coating wax with silex and plaster, I fill balance of flask with Brophy's imperial investment compound and after drying, I place in a coal stove and leave till it is all red hot. Then it only takes a few minutes to melt gold and force home, and as there is quite a body of investment around the tooth, it has not time to cool before the gold comes in contact with it. I have made a four-tooth bridge by this method and all facings were intact.—*Dental Review.*

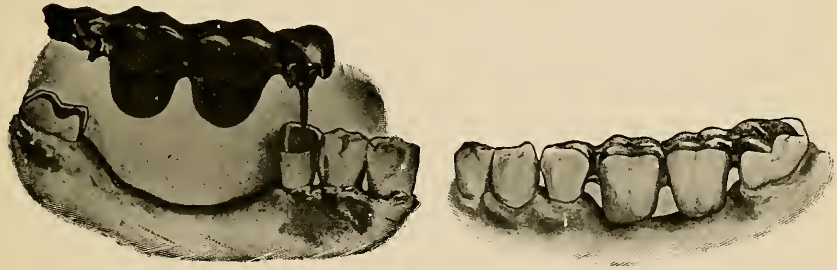
CASTING OF LARGE BRIDGES

BY W. H. HAYDEN, D.D.S., YOUNGSTOWN, OHIO

Editor The Dental Summary:

Dear Doctor:—I have read with much interest all that I have seen in any of the magazines with regard to casting, especially bridge casting and other large cases. In the February SUMMARY I noticed a little item by Dr. J. G. Lane, of Philadelphia, saying that large pieces should not be attempted because of shrinkage and consequent misfit.

I have cast at least twenty bridges, of three to six teeth each, on two and three abutments, and two eight-tooth pieces on four abutments, one having eight facings, molding these in the mouth without impression or model, and I must say I never inserted as fine-fitting bridges by any other method..



Description: Two dummies, porcelain faced, anchored by an inlay in occlusal approximal surfaces of second bicuspid, with post in root canal, and distally by an inlay in a compound mesial and occlusal cavity in third molar.

Here is an illustration that may help readers to understand:

Description:—Two dummies, porcelain faced, anchored by an inlay in occlusal approximal surfaces of second bicuspid, with post in root canal, and distally by an inlay in a compound mesial and occlusal cavity in third molar.

I would advise placing an iridio-platinum wire of generous size throughout such pieces, and a very convenient method of doing that, in such cases as that shown, is to bend the wire that forms the post in the bicuspid at right angles, and letting it extend into the cavity in the molar, thereby greatly facilitating waxing-up and carving. It, of course, adds great strength to the finished piece.

It is needless to say that I use the Elgin casting appliance, and cast directly onto the facings, the checking of a facing occurring so seldom as not to be taken into consideration.

THE IMPRESSION METHOD FOR INLAY WORK

BY HENRY W. GILLETT, D.M.D., NEW YORK CITY

Since the introduction to dentists of gold casting, a large part of the dental profession has been concentrating its energies on the technic of the casting process. As a result many variations have been evolved and published. Prior to Dr. Taggart's introduction of the cast gold inlay, and antedating it by a period sufficient for many of us to have adopted it for constant use in filling cavities of medium and large size, we had the so-called matrix, or two-piece inlay.

When the cast inlay became possible, many operators who had been using the matrix found it easier to adapt to the new process the technic they were already familiar with, than to develop the technic devised and so successfully carried out by Dr. Taggart.

This so-called indirect, or impression method, has been repeatedly shown at clinics, but I think it has not been as carefully described in our literature as it deserves to be. Because of this belief, I was easily persuaded to endeavor to present the merits of the process pursued by many successful practitioners, especially at is gives me an opportunity to urge upon you the need for, and the practicability of, further advance in the perfection of this branch of our work.

In order that we may understand each other, I desire to say at this point that in speaking of gold inlays, or gold restorations, I have constantly in mind inlays or restorations that fit the cavity margin accurately at all points, and that reproduce, as far as possible, the anatomical features of the parts they replace. In my estimation inlays are failures if they show a cement line, lack approximal contact, or present smooth occlusal surfaces.

The type of inlay I shall have most in mind is the ordinary occluso-approximal of at least medium size, and from this up to complex restorations of whole crowns.

In order to direct your attention at once to the points I desire to emphasize, I will first enumerate some of the advantages which I believe accrue to the user of the indirect inlay method, and will then, at the risk of being tiresome, endeavor to describe in detail the steps of that method.

In conclusion I shall call to your attention the need for further advance in our technic with regard to reproduction of occlusal surfaces.

Among the advantages which I personally find in the indirect method are the following:

First: Superiority of fit and ability to use an alloyed, and consequently harder gold without interfering with this superior fit. My usual choice for inlays is an alloy of 97½% pure gold and 2½% pure platinum. In cases where greater hardness is desired, a higher percentage of platinum may be advantageously used, but the 2½% alloy presents the advantage of sufficient ductility to permit of the manipulation necessary to correct the errors accompanying the casting process.

Second: The fact that we have in this process a hard die or cast of the cavity on which this necessary correction can be done.

Third: The comfortable feeling that comes from the knowledge that if anything goes wrong in the casting process itself where it is less easy to guard against error, it is simple to start afresh without recalling the patient, since the same die and occlusion are at hand, and will serve to make a dozen reproductions, if necessary.

Fourth: Opportunity for more perfect carving of anatomical characteristics in complex cases, and opportunity for finishing on the die, relieving the patient of all finishing in the mouth, except the final burnishing of the margins, and the slight polishing needed to remove the burnisher marks, thus conserving the time of the patient.

Fifth: The removal to the laboratory bench of all the carving and finishing at the hands of an assistant, and the consequent saving of the operator's time, and the enlargement of his capacity to turn out work.

It has been for some years my expressed belief that the same care and attention to detail by either the direct or indirect process would produce similar results. I have more recently come to feel that for all work except the conspicuously simple cases, the indirect process will average to turn out better results; that, contrary to the frequently expressed opinion the finished product is actually separated from the cavity by fewer steps conducive to error than when the direct process is followed.

It is generally held by advocates of the direct process that the indirect process introduces two extra chances of error in the taking of the impression and the making of the die.

Frequently we hear the claim made that the wax model exactly fits the cavity, and that the gold casting reproduces it with absolute exactness. Neither of these statements is generally true under the conditions necessary in our work.

The wax model necessarily changes in volume on being transferred from the temperature of the mouth to that of the operating room and again on being invested, the investment expands in the drying, wax burning and casting steps in a ratio usually unknown to the workman; worse still it often appears to warp in directions to which the workman has no clue except as supplied by the ill fit of the casting.

It is my belief that the errors in the taking of cavity impressions and those in making the die or duplicate of the cavity are more easily within the control of the operator than are those liable to occur at nearly every other step of the casting process—consequently I hold that when those two steps have been well performed the operator can, by the aid of the resulting die, correct most of the errors occurring in the subsequent steps and that his product will suffer less from errors influencing its fit. In short, I contend that until such devices as Taggart's Wax Warmer and Van Horn's device for maintaining body temperature during investment are obtainable, until investments are better understood, and the errors in their manipulation better guarded against, greater accuracy of fit will be possible by the indirect process than by the direct process, assuming similar conditions with regard to care and skill in both instances.

The description of the steps which I am about to give you will show you that there is greater chance of controlling error due to shrinkage of the impression material, when taking the cavity impression, than there is of controlling that of the wax model when made in the cavity, because it can be kept better under pressure and some of its shrinkage compensated for in the earlier stages of its cooling by forcing it further into the cavity. I think it will be conceded without much argument that we have amalgams from which dies may be made, which reproduce with but very slight error the form indicated by the impression.

I will now attempt to describe in detail the steps of the process.

Cavity Preparation—The only special point to note as different from any inlay cavity preparation is that in bell-shaped teeth it facilitates the work to cut back the approximal contour making a flat approximal wall. This is not feasible in many mesial cavities, but in distal cavities and others so placed that it will not result in undue exposure of gold, it permits the bringing of the approximal margins of inlays to the area of immunity with less sacrifice of tooth tissue and with less discomfort for the patient than if the whole cavity is broadened to the line of safety.

The impression of a cavity so prepared is less likely to be injured in withdrawal.

The Bite—The cavity being prepared, the next step in my own routine is to get a wax bite with sufficient accuracy to permit placing the die in it in its correct relations to the opposing and adjoining teeth.

If the die is inaccurately placed then the finished work will be wrong in contour, or occlusion, or both. Sometimes I take also a small impression of opposing teeth from which a cast is made for setting into the wax bite, and this is frequently the more accurate procedure, as it usually provides a more perfect reproduction of the opposing teeth than does the imprint in the wax.

In taking the wax bite. it is preferable to select a fairly hard wax so it will be rigid when cold, and thus stand handling when placing the die without resulting distortion. When taking the bite place the vaselined fingers of one hand each side of the teeth containing the cavities so as to prevent lateral spreading of the wax, and with the fingers of the other hand mold the wax first well into the cavities and then flatten it till the depth of wax into which the opposing teeth are to bite is reduced to the minimum required for the imprint of the desired portion of those teeth. If there is a large surplus of wax it tends to flow out laterally when the patient closes the teeth and thus distorts the impression of all the teeth included. Some patients can materially assist by maintaining closure and molding the wax against the teeth with the tongue while the operator does the same on the buccal surface with the fingers. Sometimes it is well to chill the wax before removal, but usually the surplus is sufficient to permit of its immediate removal without distortion.

Taking the Impression—Several materials are in use. The writer prefers "Perfection Impression Material" because it softens at a low temperature, and quickly becomes rigid on chilling. There are numerous variations of technic for getting the impression, but underlying all the desirable ones are two general principles. The *first* is that the impression material should always be so confined as to cause it to be pressed directly against all parts of the cavity, particularly all margins. The *second* is that the deeper part of the body of the material to be used should be firmer than the surface so that it shall serve as a support to hold the softer parts up to their required office, and as the whole mass is being cooled under pressure, to force the softer parts closer, if they tend to contract away from the surfaces of which an accurate imprint is desired.

This is accomplished in various ways. For short root ends, or for complex restorations where a whole occlusal surface, or more than three surfaces of a tooth are included in the restoration, it is frequently desirable to fit a seamless band of soft copper, or other metal, proceeding as if to fit a crown band except to have it a little looser. When this is complete a block of impression material is formed to a cone shape, having its tip just soft enough so as to avoid stickiness, and is then pressed well home with the fingers, and kept under pressure while being cooled by a stream of cold water, or better, a stream of compressed air at 20 to 30 or more pounds' pressure. The latter plan is preferable to most patients because less irritating to other teeth, and it is neater.

With the opposite extreme in cavities—the simple four-walled cavity, just a stick of compound and an instrument to keep the gum away if it be needed, serves better than any cup, as the solid base of the block of impression material takes the place of the cup, and confines the softer portion.

For ordinary occluso-approximal cavities, cups made of German silver, platinoid or the Roach Impression Cups are preferred by many, and serve admirably. In using these cups it is important that after placing the material in the cup the whole mass be cooled and the surface again softened so as to provide for the hard base of material already referred to as essential to success.

I have left to the last the technic which I use most frequently, and which I consider best adapted to making sure of a well defined imprint of all parts of the cavity margin of occluso-approximal cavities, extending to or beyond the gum line. Selecting a piece of platinoid of 32 or 34 gauge a little narrower than the length of the crown of the tooth in hand, and long enough to permit of its being curved around so as to cover its lateral sides 1-3 or 1-2 way. I proceed to form a matrix by trimming the cervical side so as to impinge as little as possible on the gum, and usually cut the middle of its occlusal side in a curve with its depression in the center. This latter facilitates forcing the impression material well home as it does not have to enter so deep a pocket, and the curving around the sides of the tooth helps to confine the material and hold it to its work at the approximal margins. (*Fig. 1*).

This matrix is generally held in place with wedges of absorbent cotton tucked in between it and the adjoining tooth. If the shape of the tooth containing the cavity is such that any bit of impression material overlapping beyond the cavity margin is likely to be broken in the removal of the impression, then the matrix is wedged snugly against the cavity margin so as to avoid having such a surplus. In this case the cavity margin in the die is formed by the angle of junction of the cavity wall and the matrix. If, on the other hand, the tooth shape is such as to facilitate removal of impression and surplus intact, the matrix is wedged less firmly into place so as to allow the impression material to extend over the cavity margin and insure an imprint of the surface of the tooth adjacent to the cavity as well as that of the margin itself.

The matrix being satisfactorily placed, a piece of impression material of appropriate size and shape is selected, and one end of it warmed and formed into a cone shape. The cone may advantageously have been formed in advance by assistants, thus conserving the operator's time. When softening and shaping the material, it is helpful to keep the fingers lightly coated with vaseline. Having the cone of compound softened with regard to its tip, and firm in its deeper parts, warm the outer surface of its base enough so the corners will not interfere with exerting firm pressure with the thumbs or fingers. Oftentimes I then stick the base while thus superficially softened onto whichever thumb or finger is the appropriate one for the case, and so carry it to position, pressing it firmly to place and guiding or supporting it with other fingers as may be necessary. Sometimes this forming of the surplus with the fingers is necessary in order to insure removal of the matrix with the impressions. I keep pressure on the mass, and direct a stream of compressed air against the material, thus quickly chilling it. If the cotton wedges are accessible I usually remove them before unseating the impression. This is not essential, but sometimes facilitates removal of the impression without liability to fracture of important parts.

After the removal I immediately dry the impression with a stream of cold air, and examine it carefully with a magnifying glass to make sure that the imprint of the whole cavity and especially of the cavity margin is clear and accurate. (*Fig. 2*).

The patient is then dismissed, and the tray containing the impression, bite and card bearing the necessary instructions is sent to the laboratory. If there are no unusual conditions, I give the case no further thought until the patient arrives for the next appointment, at which time the inlay is tried in, its approximal and occlusal relations tested and perfected, if necessary, and it is cemented in place.

In the laboratory the first step on receiving the tray is to inspect the relations of the matrix to the cavity margin. If it has sprung away at all it is pressed accurately to place, a very little sticky wax applied to its exposed side, and a bit of match stuck to it, the other end of the match being firmly imbedded in wax. This provides a brace that holds the matrix in place, and avoids risk of distorting the impression, which would invariably follow if enough hot wax to hold the matrix were to be applied directly to it while under pressure sufficient to retain it in position. The hot wax would soften the material on the other side of the matrix and cause it to yield under the pressure. Numerous other ways may be equally satisfactory, but this one is efficient and simple.

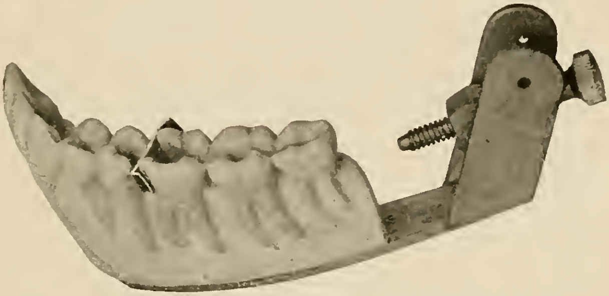


Fig. 1

Fig. 1—Typodont with prepared cavities and matrix in position ready for impression of one cavity.

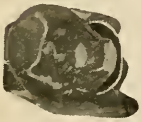


Fig. 2

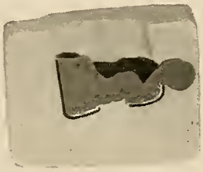


Fig. 3

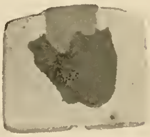


Fig. 4

Fig. 2—Impressions of cavity with matrix in place.

Fig. 3—Section of impression and plaster investment as it would stand when ready for packing die.

Fig. 4—Section of a packed die before removing impression and investment.

In the case of double compound cavities with two matrices in the impression, a ring of stiff wire slit on one side may be opened enough so as to exert the correct amount of pressure when its ends are applied to the matrices, and a minimum of wax added at the point of contact.

Investment of Impression—The matrix being secure a quantity of plaster is mixed and at the moment when still soft enough to permit of so doing, and yet not so soft as to flow in and cover it, the block of impression material and matrix is pressed straight down into the plaster in such a manner as to leave the impression exposed at the bottom of the opening in the plaster made by the passage of the mass down through it. Careful examination is now made to see that no part of the impression is covered with plaster, and any irregularity in the sides of the hole or pit is filled in so as to avoid needless surplus in the die.

The result is a plaster block encasing the mass of impression materials, except with regard to the surface bearing the imprint of the cavity, which lies exposed at the bottom of a hole of a depth equal to that desired for the die, and of a diameter approximating that of the crown of the tooth involved. (*Fig. 3*). As soon as the plaster has set the die may be packed.

Packing the Die—The hole in the plaster as described is the mold into which amalgam is to be packed to form the die. Select any good amalgam in sufficient quantity, and reduce it to a smooth plastic mass, such as is obtained by encasing the mass resulting from triturating in a mortar in a sheet of rubber dam and gathering the rubber tightly around it; or by dropping it into a rubber finger cot, and gripping that closely around the mass, and rubbing the resulting knob vigorously against the palm of the other hand. From the soft plastic mass thus obtained take a small portion and with rounded points and burnishers of such size as are adapted to the impression in hand work it carefully onto the surface of the impression, placing it definitely into all inequalities and small depressions.

As the surface of the impression becomes covered, larger amalgam masses may be used. Finally mallet force on a stick, which nearly closes the opening, heavy pressure with the thumbs, or with a clamp and rubber block may be used to consolidate the mass and expel surplus mercury. (*Fig. 4*). This work may be conveniently done late in the day and the amalgam allowed to set over night, but by using a quick setting amalgam the time may be shortened. When the die is removed from the impression, imperfections, if any, and surplus near the margins are carefully removed, and the sides of the base are given a slightly-tapering shape away from the occlusal surface to facilitate seating and removal from the plaster cast. Usually if one or more dies are to be seated in the same cast, or if the base of the die is of a regular shape, a groove is cut across its bottom so as to indicate its seat in the cast, when working on it at a later stage, without need for trial.

The finished die is then carefully seated in the wax bite. In doing this observe any portions of wax that interfere, and trim them away until the die is accurately seated, depending upon the fit of such portions of the die as you know to be accurate for your guide on this point, and ignoring all parts where surplus has been removed. Having seated the die and waxed it to place, select an articulator, preferably one provided with a lateral as well as a vertical hinge movement, and filling with plaster the portions of the wax bite on the side containing the die, mount it in the usual manner. If the imprint in the wax is to be used for reproducing the opposing teeth, that may be filled also and the mounting completed from the single mix of plaster. If a cast made from a separate impression is to be used it may sometimes be seated in the wax bite at the same time with the die or it may be seated after the cast containing the die is run and mounted on the articulator, and then attached to its articulator arm. When the wax has been removed, and the surplus plaster dressed away, the result is a replica (*Fig. 5*) of the condition in the mouth that permits of free manipulation in carving the wax duplicate with no hindrance from tongue, cheeks, saliva, overlapping and bleeding gums, poor light, difficult access and nervous patient. The wax may be pressed into place with the aid of a matrix, and held under pressure until chilled, the die may be lifted out and all margins exposed to close scrutiny under direct light, the carving may proceed under the most favorable conditions, and at the hands of an assistant, who can, with training and practice, easily produce results in that particular line that excel in perfection the work of the average practitioner. For this branch of the work young women often prove very valuable assistants.

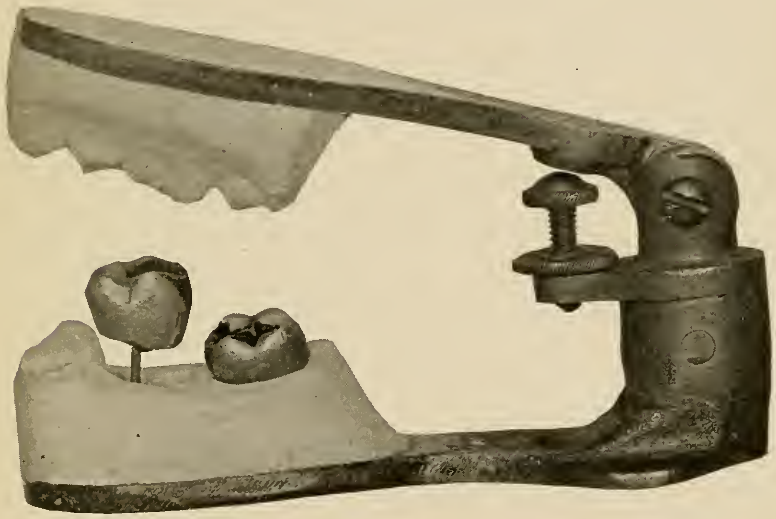


Fig. 5

Fig. 5—Dies mounted in casts on articulator. One die lifted out to show its shape.

The carving being complete, the process of casting does not vary from that to be pursued in any casting, but when that step is completed the casting is tried in the die, all imperfections interfering with seating carefully noted and removed, and the rough finishing performed first, then with burnisher and stone the margins are fitted with careful exactness, and finally the inlay, or restoration is polished ready for insertion.

If the impression has been accurately taken, the die accurately made and accurately seated, the resulting inlay should go to place without any manipulation, and needs only to be set in cement. If the contour or occlusion are not exactly right, it is very easy, having the die at hand, to place it in that and grind and polish as desired. The absence of grinding in the mouth is highly appreciated by most patients. For doing the polishing, wheels made from ordinary typewriter or ink erasing rubber will be found most efficient. The ordinary round typewriter eraser, costing four cents, will make four wheels five-eighths of an inch in diameter, and when once used they become an indispensable adjunct in this work.

In complex restorations, where the whole top of a tooth is to be restored, the indirect process reaches its fullest fruition.

It is a great satisfaction to be able to remove a gold shell crown, whose fit is such that "sloppy" is a mild term for describing it, and on finding that the previous shaping has left the lateral sides intact, to replace it with a hollow case restoration supplying perfectly every requirement of a useful tooth and every mechanical requirement as to support without the need of a band encircling the root, to foster uncleanliness at the gum margin.

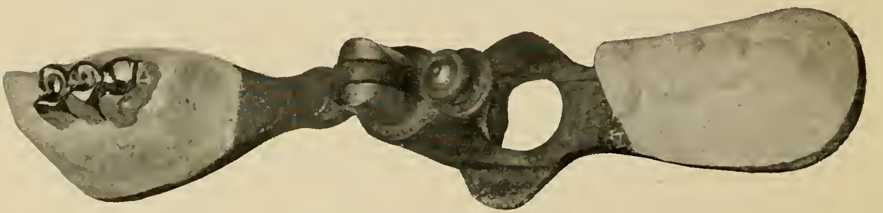


Fig. 6

Fig. 6—Example of pronounced cusp carving with round bottomed defective sulci.

The men who can do in the mouth the required carving for such a case are exceedingly rare, and when such a carving has been completed, with the expenditure of much effort and patience, the risk of a slight mishap spoiling it, and the difficulties of perfecting its fit in the mouth after it is cast, are considered, it is removed from the list of feasible operations.

With the indirect process, however, such a restoration becomes almost as readily feasible as the filling of an ordinary cavity, and the perfection of fit and contour are sources of much satisfaction.

For complex restoration I frequently cast first a 24-karat base (*Fig. 9*) and fit it to the die, and then cast on it the desired platinized alloy. This results in a very perfectly fitting restoration since the pure gold base is easily manipulated on the die, and any desired degree of hardness is obtainable with the alloyed gold used for the rest of the casting. Usually my laboratory associate prefers to cast this platinized top separately, having formed the wax over the pure gold base in its seat on the die, and after so casting the top to solder the two together. (*Fig. 10*). In that case he uses one of the well known solders for which the formula has been given us by Dr. Fred A.

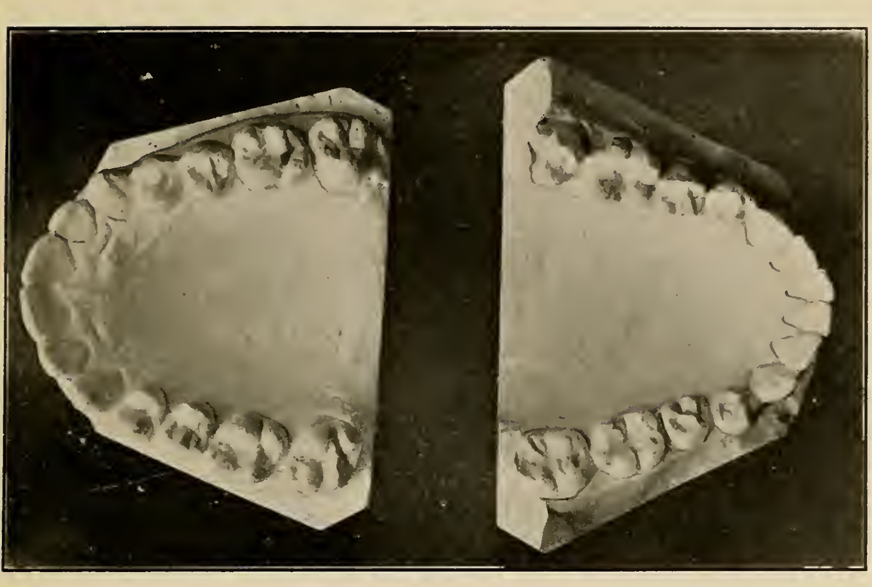


Fig. 7 (a)

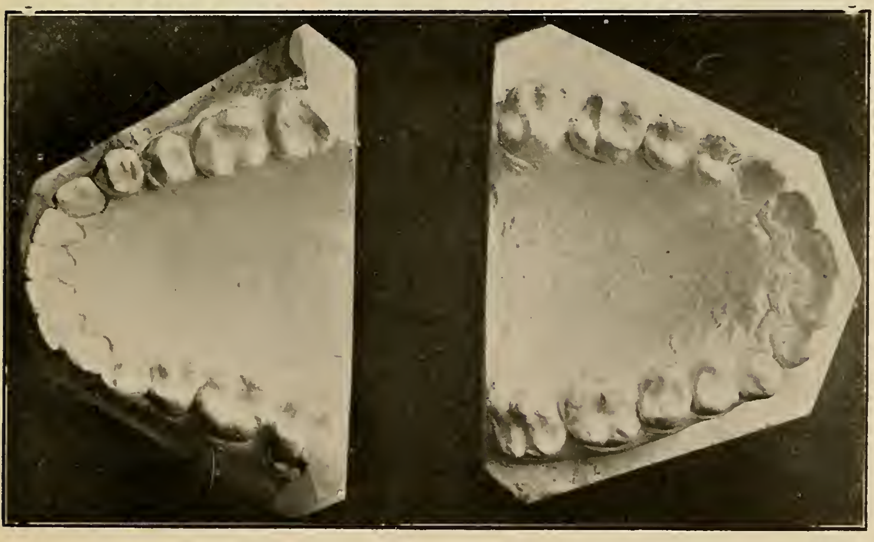


Fig. 7 (b)

Fig. 7—Cast from an orthodontia case of Dr. J. Lowe Young's showing normal condition (a) and condition after inlays were inserted a few years later (b)

Peeso. This solder matches so perfectly the color of a 2½% platinum alloy that when used to add a contact point, for instance, it can not be detected, after being well polished.

As this solder is so readily made and so serviceable, I give the formula here for the benefit of those not familiar with it:

Coin gold, 20k. solder; equal parts; fuse thoroughly on charcoal block and roll thin.

The melting point of the solder is high enough so ordinary 22k. solder may readily be flowed on it.

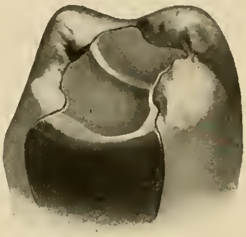


Fig. 8 (a)

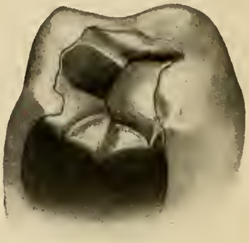


Fig. 8(b)

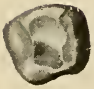


Fig. 8 (a)

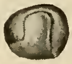


Fig. 8 (a)

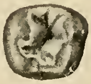


Fig. 8 (b)

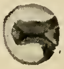


Fig. 8 (b)

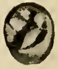


Fig. 8 (b)

Fig. 8—Illustrations of defective (a) and good (b) occlusal surface carving, by courtesy Dr. J. Lowe Young and *The Journal of the Allied Societies.*

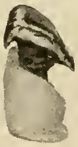


Fig. 9

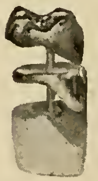


Fig. 10

Fig. 9—Die and 24K base for complex restoration of molar with overlap ready to be fitted to the die.

Fig. 10—Die, 24K base, and a 2½ per cent. platinized cast cusps for complex molar restoration, the two latter ready for soldering together.

Such complex restorations are of great service in restoring badly broken-down molars, and with the addition of dowel pins they are frequently most serviceable as bridge abutments.

These steps seem long in the description, but if proper assistance is at hand, the process, as described, can be made to conserve the operator's time and enlarge his earning capacity. Intelligent young women make very satisfactory assistants for this work, and there is no part of it that they can not readily learn to perform.

It remains to be stated that in the case of the practitioner who does all this work with his own hands, there is doubt as to his turning out as much work by following the steps as described as by the direct process, but it is my belief that he will turn out work that will be of greater service to his patients. If that same practitioner will, however, take the needful time to train an assistant to do the routine steps that go on at the laboratory bench, he will find a material increase in his efficiency.

I now desire to call your attention to the need for further development of our technic in the matter of restoration of the anatomical features of occlusal surfaces. All the previous generations of dentists have been working by methods that did not permit, within the bounds of reasonable effort on the part of the operator, or of reasonable endurance on the part of the patient, of restoration of the sulci, ridges, pits and grooves of occlusal surfaces, and even the restoration of cusps was more often than not necessarily omitted. The resulting even-surfaced fillings served ordinarily to preserve the teeth, but not to preserve their full function. Those of you who do orthodontia realize the imperative need for cusp restoration, and I doubt not that some of you have been asked why teeth with large fillings served so poorly as masticators.

At this point, with your permission, I desire to quote a few sentences from an unpublished paper by Dr. J. Lowe Young, read before the Academy of Dental Science, and to be published in "*The Journal of the Allied Societies*:"*

"Did it ever occur to you that the orthodontist often works for years to build up this normal occlusion, only to have it pulled down in a day by ruthless extraction of a single tooth, or by the lack of restoration, by the general practitioner, of cusp contour or approximal contact in making fillings or inlays?

"It would seem, therefore, that the dentist must share the responsibility of the orthodontist in emphasizing the importance of normal occlusion by preserving it at all times, and at least by not destroying it.

"Hence, if the general practitioner is to properly restore any part of the dental apparatus, he, like the orthodontist, must have in his mind's eye the forms, surfaces and positions of the dental organs when normal.

"The value of proximate contact, the proper occlusion of each cusp, the size of each fossa, and the direction of each sulcus, should be known to him who aspires to restore or re-create these anatomical forms."

For a time after the introduction of the cast inlay we were fully occupied in coping with the difficulties of technic, and the problems of marginal fit and anchorage. Now that these have become so well understood it behooves us to consider the fact that the casting process enables us to carve accurate reproductions of any tooth surface

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*Note.—See June, 1912, *The Journal of the Allied Societies.*

with but little extra expenditure of time, and to restore broken-down tooth surfaces in a manner that shall leave them very close to normal in efficiency.

I confess, with regret, that my own development in this line has been slow, and I look back with sorrow to large occlusal inlays only two years old because they were finished in the sweeping curves of our earlier technic.

Later on I reached the point of full cusp and sulcus reproduction (*Fig. 6*) and realized that this meant progress, but cases that satisfied me six months ago I now regard with regret because they were so carved that the bottoms of the sulci could be polished, and this meant absence of the grooves and pits that belong there, and which play an important part in the mastication of food.

The cusps of opposing teeth should never reach the bottoms of sulci. If they do, there is much greater risk of splitting the tooth, and the absence of sharp grooves at the bottoms of the sulci mean lessened masticating efficiency. Compare *Fig. 7* (a) and *Fig. 7* (b), also *Fig. 8* (a) and *Fig. 8* (b). Since we are now readily able to supply them, there is no longer a legitimate excuse for the absence of sulci, ridges, fossae, grooves and inclined planes from the occlusal surfaces of our inlays and restorations.

They may be carved into the wax surfaces with appropriate instruments, and gravers and burnishers of similar shape may be used for finishing if necessary, but such a surface as is left by the casting process, when carefully performed, with the anatomical features preserved, is of greater service to our patients than polished surfaces with those features absent.

A realization of this fact and the logical action on our part means that in the future a filled tooth will be as useful in performance of function as a sound tooth, and that our work will have mounted to a higher plane of usefulness to the world.

HOLLOW CAST INLAYS

BY DR. W. S. PAYSON, CASTINE, ME.

In making a hollow cast inlay after the wax model is on the sprue, build up the investment on the sprue side and let it harden; then, with a small drill in the engine, drill out the back of the wax to the extent of the cavity wanted in the back of the inlay, and finish the investment.

The first investment holds the wax firmly. The drill is better than a lancet for cutting the wax. Particles of wax can be brushed away with a very fine brush.

A hollow inlay is more firmly held by the cement, and less gold is used.—*Dental Cosmos.*

THE CAST GOLD INLAY.

BY C. G. MYERS, D.D.S., CLEVELAND, OHIO.

In filling some inaccessible cavities with the smooth point it was my practice to burnish certain pieces of gold to the mass of filling and this in time became my practice throughout the entire filling.

A double-end amalgam instrument was converted into a burnishing instrument and all my fillings were introduced into the cavity by the burnishing process and without the use of the mallet.

By the use of any of the above methods a great number of details had to be perfectly carried out, for the slightest imperfection in almost any part of the work meant an imperfect whole.

Like all other innovations, cast gold fillings must run the gauntlet of the skeptic and the knocker. About the time that I took up the practice ot dentistry, crown and bridge work was just coming into use and how it survived the many knocks it received at that time is more than can be figured out. It was claimed that is was unsanitary, unsightly and that the life of it was very limited. It was only when a dentist found his practice drifting away from him that he began to retract some of the harsh things he had said about it and added it as one of the means of extracting a livelihood from his profession. The same will be true of the cast gold inlay as was true of crown and bridge work. Some few will make a success of it and others will not because it is an apparently easy process.

The process is in its infancy, and the appliances are crude, as compared to what we will have in the future. Mistakes will be made, but through these mistakes will come ultimate success.

Let us look at some of the features of elimination brought about by this work. If it had nothing to recommend it beyond the fact that the teeth did not need separation, which I know from personal experience is a barbarous practice, it would need nothing more than this to class it as an ideal method of restoring lost contours in teeth. If it has eliminated the rubber dam, this alone would recommend it to the helpless victim whose sufferings in the application of this necessary adjunct to the old methods of filling teeth were only equaled by the tortures of the inquisition.

Who has not suffered from the application of ligatures? Who has not suffered from having a sore tooth malleted upon until every blow seemed worse than the one previous and then the final tortures of the disks, stone and strips in the finishing process until dentist and patient were about as nearly nervous wrecks as they possibly could be?

No wonder dentistry and the dentist have been avoided. Even the dentist avoids the dentist. You will find in the mouths of dentists as bad a state of affairs existing as you will find in an equal number of patients. But a different state of affairs should exist today, through the methods we have by eliminating the sensation in the tooth and all of the disagreeable features formerly connected with the malleting of fillings in the teeth.

It will be but a short time when the demands of the patient will compel us all to use more humane methods in our work. The physician today who would attempt even minor operations without the use of some anesthetic would be classed as a butcher.

In regard to the technic I will have very little to say. As I said before, it is my impression that we have only a slight knowledge of the possibilities of this work and our methods up to the present time are very crude. I feel that Dr. Price with his pressure gauges and heat gauges is on the right track when it comes to getting perfect and uniform results.

Up to the time the cast inlay was introduced, large restorations of the tooth were very frequently made with amalgam or crowning. But it is now possible to save teeth in a way that crowning has to be resorted to only on rare occasions. As attachments for bridges where at one time extensive grinding of tooth structure was necessary or gold was unnecessarily displayed, we can now use gold inlays and gold overlays with pins running into the root canals as attachments for practically all bridges, and the resulting work is not only practical but substantial and beautiful.

For a great many years all-gold crowns made by me were made after the method suggested by Dr. J. Rollo Knapp, of New Orleans. The result obtained by this method were perfect for this class of work, but the number of details to be carried out was enough to discourage almost any beginner in this work. The same results or better results are now obtained through our knowledge of casting and with no more details than was required in the old shell crown. The construction of bridges both gold and porcelain at one time meant a multitude of details in its construction, but now with a few simple fittings a bridge constructed in wax with porcelain facings in place, a bridge of any size can be made in one casting and we have never made such perfect fitting plates as we have made by the casting process.

My method of making inlays consists in making a wax pattern of whatever is to be reproduced, investing this in one of the different investing compounds furnished by the dental supply houses, and using either centrifugal force or the vacuum for forcing the gold into the matrix. In casting directly on porcelain there is no more danger of checking the porcelain than there was by the use of the blow-pipe. It is only necessary that the temperature of the investment and porcelain be raised to the fusing point of the gold.

There are only two ways that the busy dentist can increase the income derived from his practice. one is by increasing his fees and the other by increasing his output of work. It is very hard for a dentist with an established practice in a certain locality to very greatly increase his fees, but it is easily possible for him to more than double the amount of work turned out by using the casting process.

Now, I feel grateful to anyone who will put money in my pocket, and I feel doubly grateful to anyone who will make my business cares lighter. I do not feel that it would be fitting to close this paper without expressing my gratitude to Dr. Taggart for all that the casting process has meant to me in the last few years. If I am to continue in the practice of dentistry I can do so a greater number of years and with greater profits each year than I could possibly have done under former methods. Dr. Taggart is an originator and inventor and whereas he would like some substantial returns as a result of his inventions, for the inventor is usually an erratic individual and not a good business man, he would be more touched and pleased by the generous praise and plaudits of those in his own profession. It is not for me to say whether he is right in obtaining patents and trying to enforce legally what the law says is due him, but I do know that the dentists have made a very poor show of appreciation for the many benefits they have derived from what Dr. Taggart has taught them. Whether casting was known to the Egyptians or Phoenicians cuts no figure in this case. Dr. Taggart taught you what you know about this process and the chances are if it had not been for the energy, the sleepless nights and the outlay of money that Dr. Taggart has put in this work, we all would be plodding along in the same old rut.

THE CAST CLASP

BY W. B. CALDWELL, D.D.S.

The cast clasp or band, used in retaining partial dentures, is found to be quite satisfactory, made after the following method: First moisten plaster tooth to prevent wax from adhering, soften inlay wax and shape to desired thickness and width; press around plaster tooth as far as clasp should extend; (also, in cases where molars or bicuspids are to be clasped, and the articulation will permit, allow a spur of wax to extend over into the sulcus); by so doing the clasp will not allow the plate to settle, remove the wax after having shaped to suit the case, and invest as usual. If a lug is desired, shape and unite with wax clasp, cast in one piece.

Another Method—Take a separate impression of tooth to be clasped, pour a cast of plaster and XXX silex, equal parts, having cast prepared, melt inlay wax and paint it on tooth over area to be covered by clasp, then invest without removing wax from tooth. Care should be taken not to have clasp too thin as the cast metal is more liable to break than clasp plate. A partial denture constructed with cast clasps is very pleasing when inserted and quite practical, as there is no spring or rocking to the denture.

A COMBINATION CAST CROWN.

BY O. H. SIMPSON, D.D.S., DODGE CITY, KANSAS.

The all-cast crown has about as many objectionable features as either the seamless or cap and band crown, and it occurs to me that by combining the two pocesses a much superior crown can be made.

In the all-cast crown it is practically impossible to get band below margin of gum without an element of guess work; besides the band is apt to be clumsy and has little or no tensile strength, which renders it unfit for support of bridge work. If it were not for the fact that the seamless is less angular in form than the average cap and band crown, and the absence of the solder line, there would never be a seamless crown used.

The ease with which the band can be adapted to the root makes up in a great measure for the difficulty experienced in getting a graceful union between cap and band. If any extensive reinforcing is done there is always more or less risk connected with the process, and besides, it is difficult to get the thickness where it is most desired, and the solder is apt to shift at any subsequent heating of the crown.

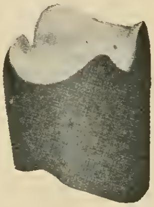


Fig. 1

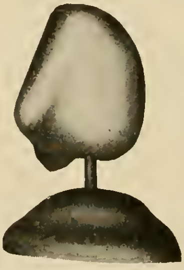


Fig. 2

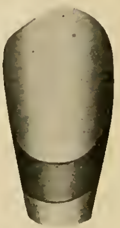


Fig. 3

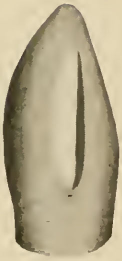


Fig. 4

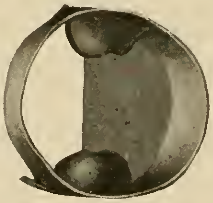


Fig. 5

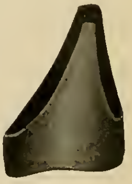


Fig. 6

Most of the objectionable features can be overcome by cutting the band wide enough to articulate edge of band with the opposing teeth. Place band on root, festoon and adapt band to circumference of root. The band is readily articulated with opposing teeth by having patient open and close the mouth a few times, thus showing where to trim away the band. Be sure to leave band on the buccal surface as long as the cusps of the adjoining teeth, as the distinct feature of this way of making a crown is that the band and cusps are made continuous, doing away with the solder joint between cusps and band. The cusps can be made any length or form by cutting notches in band and contouring with pliers, as shown in *Fig. 1.*

The band being longer it furnishes the operator a better opportunity to contour than the old style of narrow band. Place band back on root and readapt to proximal teeth. If it is a short stump, partly fill the open end of band with investment, leaving room for sufficient thickness of wax to make cusps of desired thickness. Finish filling the band with wax and have the patient bite down to get the articulation. Carefully remove band, carve wax to correct tooth form, preserving in a measure the articulating surfaces made by wax on opposing teeth. Fill upper end of band after removing from the root with investment; insert sprue and proceed as with any other casting. (*Fig 2.*)

I believe that the advantage of this way of constructing a crown over the short band and cast cusps can readily be seen, as the gold used in casting is not always the same color as the band, and if there is any slight defect in the casting process it is less conspicuous, as it is underneath, instead of on the side.

I have found *Fig. 3* particularly adapted to the support of bridge work on lower cuspids where the patient objects to devitalization and Richmond crowns. Prepare tooth as is shown in *Fig. 4,* cutting key seats and making sides as nearly perpendicular as the case will permit. Make band open front and back, making it fit snug at anterior cervical and sides. Allow band to gap open slightly on the lingual surface so that the keys and back will cast in one piece. *Fig. 5* shows where I have sealed or melted wax keys and wax back on dry band before forcing it down over prepared tooth. Wax will not adhere so readily to a moist band, hence the precaution to attach the keys and back before forcing it over prepared tooth. Carefully remove; insert sprue wherever it is indicated.

This band will greatly strengthen this form of bridge support, and is seldom noticeable in conversation. With care the gold at the side and cutting edge can be almost entirely concealed, as is illustrated in *Fig. 3.* Sometimes when the band is not sufficiently heated, or is too badly oxidized, the cast portion fails to adhere to band. For this reason, I advocate soldering the two together. The seam being so perfect only a small quantity of solder is required.

Fig. 6 illustrates side view of band (*Fig. 3*) before wax back and keys are attached.

COLLODION AS A SEPARATING MEDIUM.

B. L. Worthley, Trenton, Mo., recommends collodion as a separating medium for plaster impressions. A single coat, followed when dry by a little soapstone rubbed over the impression, insures a clean parting and a smooth cast.—*Dental Brief.*

DESCRIPTION OF AN INTERESTING CASE RESTORED BY ALL-PORCELAIN BRIDGE AND BRIDGES UPON CAST BASES

BY J. M. THOMPSON, D.D.S., DETROIT, MICH.

During the last week of July, 1908, Miss A., a non-resident patient, presented for restoration one of the worst cases of broken down roots (which had previously supported their own and artificial crowns) that it has ever been my fortune to see. The necessities of the case and the fact that it would be of interest to others did not impress me sufficiently at first to warrant my making photos, models, etc., before beginning the work. It was after having an X-ray picture taken to locate a missing cuspid that it impressed me as a remarkable case.

Fig. 1, as presented here, is the X-ray picture, and that it may be fully understood, the reader will simply assume that he is looking from within outward, and the description will be easily followed.

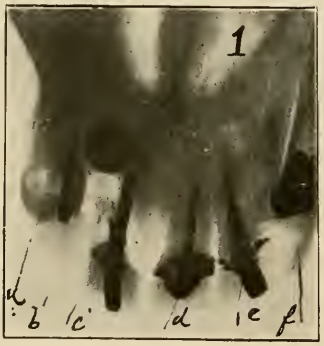


Fig. 1

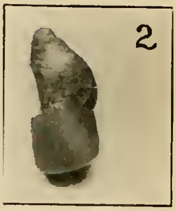


Fig. 2

Reading from left to right, we find the first biscuspid the only natural crown in the upper jaw. Letter "a" shows a broken-down lateral root supporting a crown held in position by a twist of cotton. Letter "b" shows unerupted cuspid resting against apex of broken-down central root. Letter "c" shows porcelain crown with dowel extending into central root, around which is a roll of cotton which retained it in the gum and tooth. Letter "d" shows right central, a devitalized tooth with an inlay set in one side of the root for the purpose of properly shaping the end so that a porcelain jacket crown could be fitted, the crown being shown in position. Letter "e" shows another porcelain crown also held in position by a twist of cotton, and letter "f" another held in by the same method. It is needless to say that the patient was somewhat of an expert in wrapping of cotton around the dowels of these crowns, and two of them were so securely fastened that considerable force was necessary for their removal.

Figure 2 shows central incisor with cotton still in place, having been worn part of a day before the root was removed.

A bridge of three teeth was first made for the lower jaw (right side), consisting of a shell crown upon the third molar, a Davis crown upon a cast base, for the first molar, with a diatoric molar supported between them.

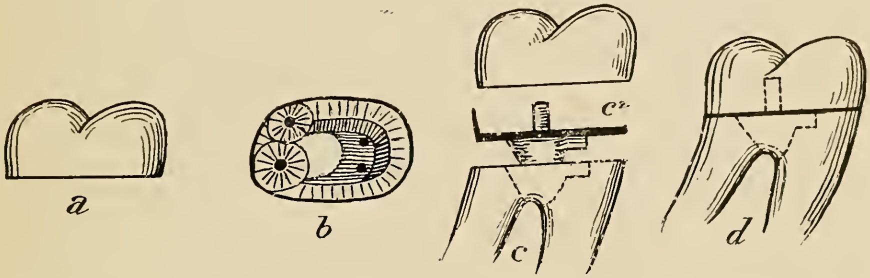


Fig. 3

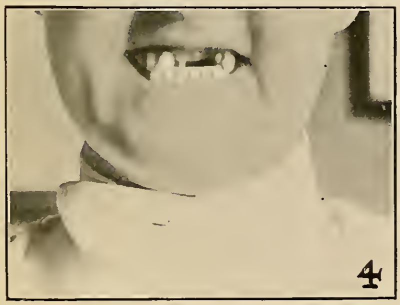


Fig. 4

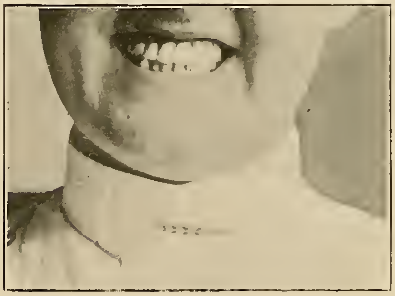


Fig. 5

The root of the first molar was of peculiar type (see a, b, c and d, *Fig. 3*), having three distinct roots with a perforation separating all three. The surface of the root was ground to a plain surface and Davis molar ground to fit the tooth as perfectly as possible, and in shaping the porcelain molar it was necessary to place it in the furnace to restore the glaze. A piece of No. 40 pure gold foil was then burnished over the base of the crown and a post forced through the foil into the hole in the crown. The soft wax was then placed in position and the crown pressed down upon the root, the wax protruding through the perforation somewhat. This was trimmed off and again adjusted, and then removed and the polcelain crown taken away and a casting was made with gold foil in place. When completed, a very thin line of gold was all that would give any evidence of its being used upon a gold base.

A bridge for the upper jaw (right side) was then made, consisting of a Davis crown cuspid upon a cast base, a gold shell for the first molar with two bicuspids made by waxing the facing into place and forming dummies for casting and then removing the facings and using lead pencil points to preserve the holes for the pins. Thus we have a bridge without putting the facings through the fire.

Next the lateral, "e," *Fig. 1,* was removed and a crown of suitable size, shape, and color was placed in position. The porcelain jacket was then removed from "d," *Fig. 1*, and the root prepared with a facer and a dowel of iridio-platinum set in position to support one end of the bridge which was to be made. The lateral root, "a," *Fig. 1,* which may be noticed as in the place of the missing cuspid, was then prepared to support the other end of the bridge.

An impression was then taken and duplicate pins placed in the impression so that the work could be made upon the model and so constructed that it would draw with perfect ease. Four facings were then selected and waxed into position with pink inlay wax upon a base of one-thousandth inch platinum, which had been previously burnished over the model. New porcelain was then placed upon the labial surfaces of the facings at the cervical portion, also covering the platinum to quite an extent. This was then placed before the door of the furnace and the wax melted out, the porcelain holding the facings in their relative positions. No attempt was made at forming a foundation at this time, as it was necessary to form a block of four teeth before attaching it to either of the roots.

When they were removed from the furnace after the first baking they were again adjusted to the model and pink gum laid over the first baking and the case again fired. Having secured the block, it was adjusted perfectly to the model, and having made a platinum foundation upon each root in the mouth, the block was then adjusted directly against the roots which were to support it. On account of possible change of shape, only one end was securely fastened at a time, and in this way a perfect fit was secured, and *Figs. 4* and *5* show the case before and after the work had been finished.

CASTING WAX

BY DR. T. C. TRIGGER, ST. THOMAS, ONT.

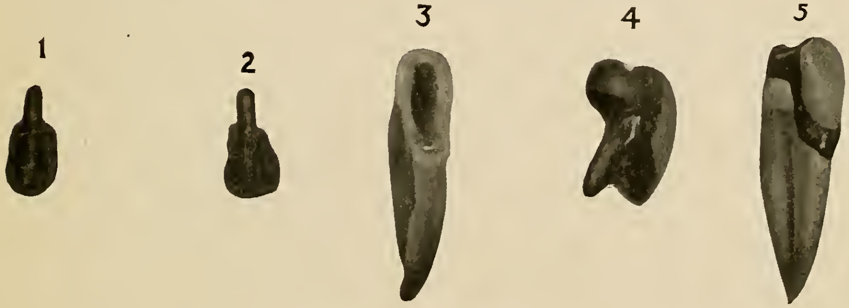
I have been using wax in various colors, and find that a rose tint is more transparent than the green, which is a very essential point, as the marginal edges of the cavity can be easily seen and the thickness of the wax can be determined, over-lapping the marginal edges. To test the transparency of wax in various colors, I made thin slices of equal thickness, and found that the rose-colored transmitted the light more than the green, and the latter had to be cut very thin before any translucency could be detected.

RESTORATION OF BROKEN-DOWN ROOT OF BICUSPIDS AND MOLARS BY CAST METHOD.

BY A. W. MCCULLOUGH, D.D.S., PITTSBURGH, PA.

This method applies principally to biscuspids and molars, which are badly decayed or broken down, or where by accident one cusp has been broken off, the break extending under the gum line, and a portion of tooth remaining.

First, after canals are placed in proper condition, pack space tightly with some good temporary stopping, and allow to remain a day or two. On removing, the margins will be exposed, and root can be shaped without injury to surrounding tissues. The root should be shaped in most retentive form, leaving a portion of remaining cusp for strength where possible.



Figs. 1, 2, 3, 4 and 5

A post may be used in canal, but usually its being so short, an impression of gold, making the whole in one, is advisable. After root is shaped, an impression of root with inlay wax, extending into canals, properly trimmed to margins, is now taken, invested and cast.

This assures perfect adaptation to root.

Sprue is now cut off and cast, the part fitted into root, impression taken in plaster or compound, model made and selected tooth built into place with inlay wax; allowing it to extend over lingual cusp in sort of a hood shape to give strength and retention, and then carving occlusion to articulation.

Tooth waxed in position, model is then trimmed as small as possible, and invested again, put on fire and allowed to heat slowly, but to a high degree, so as to assure uniting to cast base and less liability of fracture to porcelain, and then cast.

If model has been well shaped and smoothed, it will require but little polishing and make a very strong, esthetic crown.

SUBGINGIVAL AND ROOT-CANAL RESTORATION IN CROWN WORK

BY EDWARD MILLS, D.D.S., COLUMBUS, OHIO

This method is offered to meet the requirements in those cases where the root has become extensively destroyed by caries and disintegration, and the root canal enlarged considerably beyond the requirement for inserting a dowel. To obtain free exposure of the end of the root, lightly press away the soft tissue with gutta percha, repeating the procedure at subsequent sittings, if necessary, as time expended at this step will greatly facilitate accurate adaptation (*Fig. I*). After removing debris and decay, the sharp irregular edges should be carefully ground down with stones and a carborundum root facer. If sufficient portion of the edges remains, and it is desirable to use a banded dowel crown, proceed as follows:

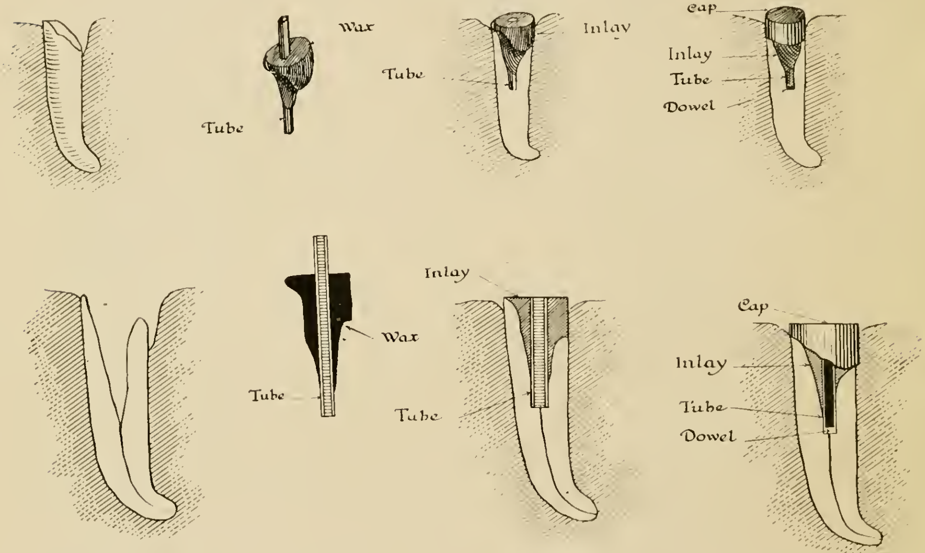


Fig. I *Fig. II* *Fig. III* *Fig. IV*

Restore the root by use of inlay wax or modelling compound, carefully trimming and readjusting until the periphery of the root is re-established. Excess of moisture is then removed and this core secured in position by powderd gum tragacanth.

Measurement for the band is now made by using Barbour's No. 3 Irish flax,* the ends twisted until the thread is tightly adapted to the periphery of the root; then with a sharp pointed surgeon's shears the thread is cut closely as possible to the root. The advantage of the thread over a wire is the pliability of the former as compared with the springiness of the latter. After cutting, the ends can be brought together and, if found to overlap, can be trimmed to a butt and an accurate measurement is secured. From this make the band of sufficient width as to permit trimming, that a portion may extend to or slightly beyond the edge of the portion restored by the core.

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*Irish flax is more economical and superior to dental floss in general use about the mouth. It can be obtained at any leather supply house.

After selecting a round or square dowel of surplus length, take inlay platinum, 1-1000 thickness, and wrap closely around the pin at least twice, making a sleeve, which is carefully slipped off and the exposed edge secured with a minute particle of solder. The sleeve is now readjusted to the dowel, correct gauge obtained and, with a bur of the exact size, the canal is extended to sufficient depth. The band is now placed in position, the dowel in its platinum sleeve is coated with sufficient inlay wax and pressed firmly to place, the wax is trimmed flush with the band and all carefully removed. The band is readily slipped off the wax and the dowel from its sleeve, leaving the latter extruding through the wax model, as shown in *Fig. 2*.

Place a piece of graphite coated with thin plaster in the sleeve. invest and cast (*Fig. 3*). After polishing, the excess length of sleeve is removed and the inlay thus fromed placed temporarily in position. With the band previously made, the cap is completed in the usual manner, adapted to place on the root, perforated for the dowel at the proper point, and the latter is pushed to its place.

To sustain the accurate relation of the dowel to the cap, a piece of modeling compound is warmed and pressed against the projecting end of the dowel and surface of the cap, cooled with a spray of water and carefully detached. If the cap and dowel fail to remove, they are easily placed in their respective positions and secured by a speck of wax. They are now invested, being careful that the interior of the cap is filled with investment, and soldered (*Fig. 4*).

The cap with the dowel is now polished, and with the tubed inlay in position in the root, it will be found to pass snugly to place. The tubed inlay is then cemented permanently in position and, with the cap and dowel, the crown is completed in the manner desired.

In cases where a band is not desired or unavailable, due to the condition of the root, the inlay with the sleeve for the dowel is prepared at once and cemented to place.

This method of restoration reduces the amount of cement to a minimum and insures an accurate and determined position for the dowel.

TO HOLLOW OUT WAX MODEL FOR GOLD INLAY

BY S. T. NEILL, CLINTON, MO.

An appliance costing a trifle can be made in a minute or two. Remove the middle point from a hypodermic needle, hold it in Bunsen burner, and pull it out with pliers; slip a foot of rubber tubing over the large end of the needle, warm it in the flame; suck gently with the lips on the tubing, while holding the warm point against the excess wax of the model. Burn out wax in the needle point by holding in the flame, and blowing through it.—*Western Dental Journal.*

PORCELAIN AND GOLD INLAYS.

BY A. W. STARBUCK, D.D.S., DENVER, COLO.

SUPERINTENDENT OF INFIRMARY, COLORADO COLLEGE OF DENTAL SURGERY, DENVER, COLORADO

In presenting these articles upon porcelain and gold inlays, it is the desire of the writer to furnish an outline of procedure which has proven very satisfactory in his hands, as well as his many students'. He claims no orginality to any of the methods, rather it is a collection of the good ideas introduced and practiced by the eminent porcelain and gold workers of the day.

The equipment recommended for porcelain inlays may be criticised by many owing to its simplicity. But as this is intended more for the practitioner who has been shut out from the use of porcelain owing to the extensive and expensive equipment supposed to be necessary, we will eliminate special instruments as much as possible, thus showing the possibilities using the ordinary equipment of general practice.

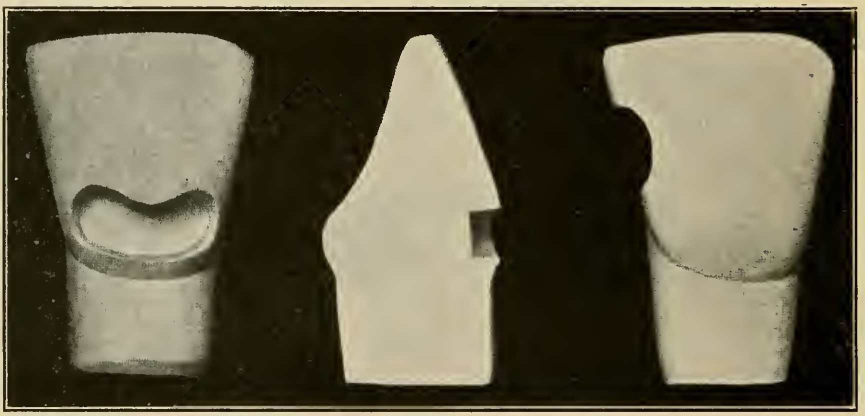


Fig. 1 Fig. 2 Fig. 3

CAVITY PREPARATION FOR PORCELAIN INLAYS

Generally speaking, cavities for porcelain inlays should be free from undercuts in the direction in which the matrix is to be removed. There should be flat seats at right angles to all possible stress from mastication. All walls should be as nearly as possible at right angles to the surface of the tooth. And all margins should be sharp and not beveled.

The cavities here presented are a composit of the good points gleaned from careful study of a series of models sent the writer by about thirty of the prominent porcelain men from different parts of the country.

GINGIVAL CAVITIES

Gingival cavities should be extended only to include all the decayed area. In doing this, endeavor to get an oval or kidney-shaped cavity as it is extremely difficult to properly insert an inlay of circular outline. This extension is best accomplished by the use of chisels and inverted cone burs. In this class of cavities there are frequently several small pits or initial seats of decay. These are best united by the use of small inverted cone burs. Then with chisels break down the overhanging enamel walls. This operation should be repeated, first using the inverted cone burs (increasing the size each time), then the chisels until the cavity is extended to sound margins and symmetrical outline. After the desired outline is reached, any undercuts that may be present should be cut away and the walls made parallel by the

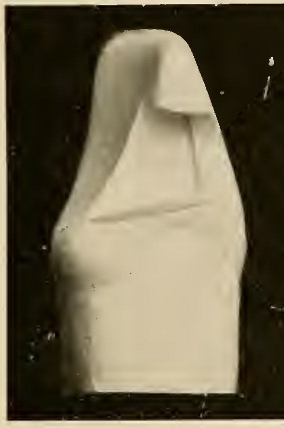


Fig. 4

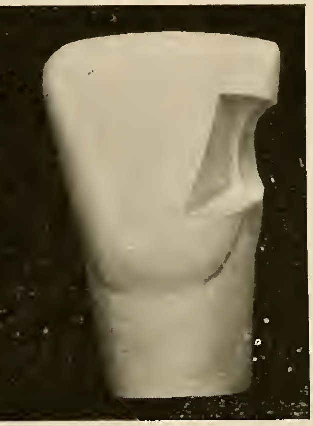


Fig. 5

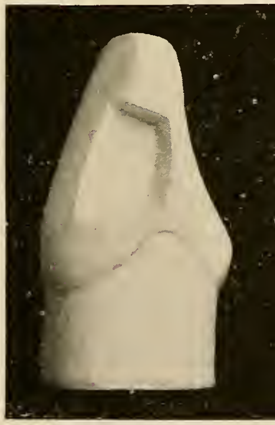


Fig. 6

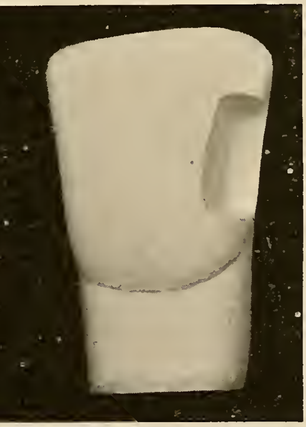


Fig. 7

use of square-end fissure burs, or better still, a similar-shaped plug finishing bur.

It is in these cavities we experience so much difficulty in securing a proper color, especially after the inlay has been cemented to place. Consequently great care should be exercised in getting the proper alignment of the margins, also proper depth to the cavity. This being an extremely sensitive portion of the tooth many inlays are failures owing to a lack in depth sufficient to give enough bulk to the porcelain to exclude the influence of the cement, saying nothing of the strength of the inlay.

Many will criticise the use of the parallel walls, citing the difficulty of burnishing a matrix to a cavity of this nature. This objection you will find entirely done away with in the methods suggested later for forming the matrix for this class of cavities. The main objections to flaring walls are the lack of retention and the objectionable change of color in the inlay from cement. The nearer you can get this cement wall parallel to the line of vision the less it will change the color of the inlay.

A final inspection of the cavity should be made to make sure there are no irregularities or small nicks in the margins. This is best accomplished with the use of a lens. The marginal walls should be smooth, yet not polished, as cement will not adhere properly to a polished surface.

The writer can not recommend too strongly the plan of seating the patient in a normal position at this time and carefully viewing the walls of the cavity to make sure they are parallel to the line of vision, as this is so essential to the appearance of the inlay when set. How often have we viewed an inlay with pride when the patient was tilted back in the chair, only to be disappointed even to the removal of the inlay when the patient was standing or sitting in a normal position!

SIMPLE PROXIMAL CAVITIES

Among the many excellent ideas brought forth and taught by Dr. Black and his disciples is one point which, if possible, is of greater value to the porcelain worker than to the gold worker, and that is:

STUDY THE OCCLUSION

as the durability of an inlay depends largely upon the manner in which stress is brought to bear upon it. This one thing should receive our first consideration. In cases where there is excessive stress porcelain is contraindicated. However, in cases with moderate or ordinary stress porcelain will prove satisfactory, provided proper cavity preparation is considered and the inlay is carefully baked.

The patient should be requested to close the teeth, first, normally, then have him move his jaws in such a manner that every peculiarity of occlusion at that particular point can be carefully noted. Frequently what at first seemed a favorable case has proved dangerous when considering the lateral movements of the jaws. Many such cases may be improved by slight grinding of an angle of the tooth or the tip of a cusp when this portion is slightly elongated.

In inlays where stress of mastication is a factor of consideration they should always be removed in the direction from which such stress comes. There should also be flat seats antagonizing any force brought to bear from this direction.

Generally speaking, proximal cavities should be so prepared that there will be no difficulty in removing the matrix where there is but slight separation.

Fortunately, the lingual wall is generally the weaker, consequently it is a less sacrifice to cut away this wall to permit the easy removal of the matrix and this is the logical procedure in the upper incisors and cuspids (the teeth we are dealing with mostly), unless we have an abnormal occlusion.

In preparing a single proximal cavity in an upper incisor, first break down the weak enamel walls, using chisels or hatchet and hoe excavators. Then with smooth, square-end fissure burs in the right angle, entering from the lingual, the cavity may be formed.

The cavity should be slightly larger at the lingual than it is at the labial to permit the removal of the matrix. The axial wall should be as nearly flat as possible and parallel with the long axis of the tooth. The incisal and gingival walls should be at right angles to this. These walls are formed with the sides of the bur, while the square end forms a flat seat under the labial plate. Any imperfections following the use of the bur may be remedied by the use of the hatchet and hoe excavators. All margins should be made at right angles to the surface and should be sharp and well defined. At this time the patient should be placed in a normal position and a close inspection made of the labial margin to make sure it is parellel to the line of vision, and if not it should be so altered as to remedy the trouble.

It is needless to say that all remaining decay should be removed. In case this should cause undercuts or pockets they may be filled with cement.

The important points for consideration are: *First,* the cavity should be larger at the lingual than at the labial; *second,* the axial wall should be flat; *third,* the incisal and gingival walls should be at right angles to the axial wall; *fourth,* there should be a flat seat under the labial plate; *fifth,* all margins should be at right angles to the surface and not beveled; *sixth,* the labial wall should be so modified, if necessary to make it parallel to the line of vision.

In case where the lingual wall is strong and the cavity is near the labial surface the preparation may be so modified to permit the matrix being removed to the labial. This would be permissible only in very small cavities and those caused by an overlapping tooth and then when the lingual wall is not involved.

The preparation of a cavity in a lower incisor, regarding the manner of removing the matrix, would depend largely upon the condition of the labial and lingual walls, but it would be preferably removed to the labial.

In cavities of this class there has been considerable criticism by many as to whether porcelain was indicated in any case. However, time has proven that they will stand, under proper conditions, even equal to the average gold fillings.

Again, it is of the greatest importance to

STUDY THE OCCLUSION

This is something that should become a habit with very dentist. Very few men even think of the occlusion until the patient goes to leave the chair and complains of the filling or crown being too high. By carefully observing the occlusion on the start, it may prevent after disaster and possibly change the entire procedure.

In cases of an edge-to-edge bite and showing considerable wear, porcelain should be used with great caution, if at all; while teeth with normal occlusion may be filled with porcelain if due consideration is made of the preparation of the cavity, and the results will be permanent and serviceable. In all cases we should endeavor to get the maximum thickness of porcelain possible. The method used by some of leaving the labial plate and building up the lingual plate only, at the incisal edge or vice versa, is a dangerous and frequently disastrous procedure.

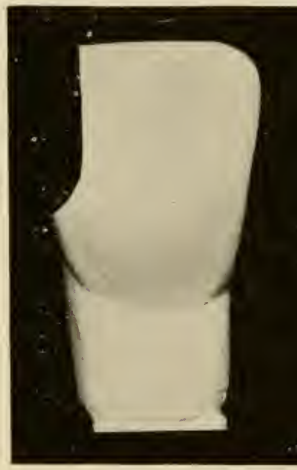


Fig. 8

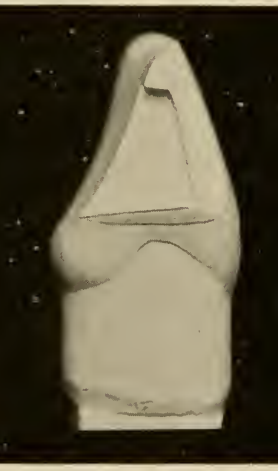


Fig. 9

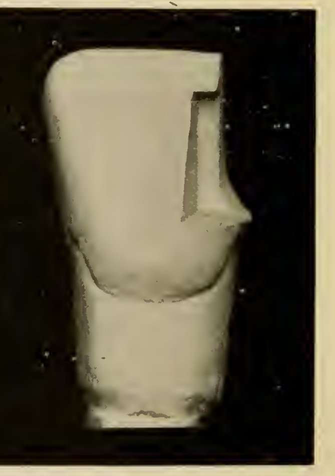


Fig. 10

The method of cutting away the labial plate (*Figs. 8, 9, 10*), to a straight line parallel with the long axis of the tooth and depending upon the depth of the cavity and parallel gingival and incisal walls upon the lingual, has merit in cases where the tooth is of considerable thickness labio-lingually and there is sufficient depth of cavity in the direction of the pulp; but as a rule there is not sufficient anchorage to withstand the stress of mastication. The better method, and I think the one adopted by the best authorities, is to gain additional retention by extending the cavity on the incisal edge, forming a step.

In shaping the labial margins, it is perferable to extend so all portions of the margins will either be at right angles or parallel to the long axis of the tooth. For example, if we had a tooth broken down as illustrated in *Fig. 11,* it should be cut away with a carborundum stone until the margin assumes lines illustrated in *Fig. 12,* rather than shaping it as illustrated in *Fig. 13,* or again in a more extreme case as shown in *Fig. 14,* instead of simply smoothing the surface of the break, leaving the general view as it is, it is perferable to form a series of steps as shown in *Fig. 15.* A cavity thus perpared will show less and in many cases have increased retention. The principal reason for such a procedure, however, is the fact that the fine line of union takes on the appearance of a developmental groove, or a natural crack in the tooth and is hardly noticeable. An inlay that is a shade or two off in color will hardly be noticeable, while a bias margin is noticeable even with a perfect match.

The matrix should be removed in the direction from which occlusal stress comes; namely, to the lingual in the upper anterior teeth with normal occlusion. In all cases there should be flat seats antagonizing any such stress.

In preparing cavity, *Figs. 8, 9, 10,* the labial plate may be formed with a knife-edge carborundum stone. The lingual plate is removed with chisels and hoe excavators; then with a smooth fissure bur extend and shape the gingival and incisal walls of the cavity sufficiently to permit the easy removal of the matrix. The axial wall should be flat and parallel with the long axis of the tooth and the gingival and incisal wall at right angles to this. The junction between these walls should be a well-defined angle and not rounded as some advocate. With the end of the bur a flat seat is formed under the labial plate. Then remove any remaining decay and carefuly inspect all margins to make sure they are sharp and well defined. Finally, seat the patient in a natural position and carefully examine the labial wall to make sure it is parallel to the line of vision from the cavo-surface angle inward. In other words, only the cavo-surface angle should be in view. Especial attention should be given to the gingivo-labial angle, as it is at this point we have a tendency to cut insufficiently. A cavity of this nature is seldom indicated as it lacks sufficient incisal retention if there is any great amount of stress.

The method preferable and generally used is one where additional incisal retention is obtained by use of a step.

The main portion of the labial wall and the step are formed with a knife-edge carborundum stone. It will be noticed in *Fig. 16* that the gingival wall of the step is not quite at right angles to the long axis of the tooth, but dips down slightly as it approaches the axial wall of the step. This is necessary to afford retention from dislodgment to the approximal as the fulcrum is at the cavo-surface angle of the gingival-surface; hence, the inlay in the step moves incisally slightly, if dislodged.

By examining *Fig. 17,* it will be noticed that the line of the pulpal wall of the step is broken, thus affording additional strength to the porcelain at this point. This is formed with a small inverted cone bur held parallel to the long axis of the tooth. The diameter of the step mesio-distally should be about two millimeters ordinarily and about the same diameter inciso-gingivally at the narrowest point; or, in other words, should be of sufficient dimensions to give strength to the porcelain.

The main portion of the cavity is formed with a smooth fissure bur in the right angle. Special attention should be given to the gingival wall to have it at right angles to the long axis of the tooth, also to have a flat seat under the labial wall. Many advocate grooving this seat near the axial wall, but this is a very dangerous procedure as there is danger of cutting through the dentin to the enamel, which would completely destroy the strength of the wall, as there is no strength to enamel when not supported by dentin. Nor is a groove along the gingival necessary if that wall is perfectly flat and at right angles to stress.

Again inspect all margins carefully to make sure they are smooth and sharp and note the angle of the labial wall, especially the gingivo-labial angle in the main portion of the cavity and the gingival wall of the step.

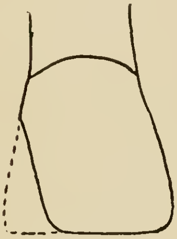


Fig. 11

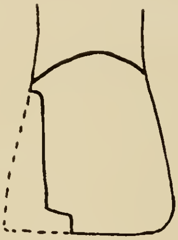


Fig. 12

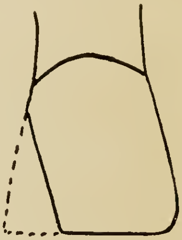


Fig. 13

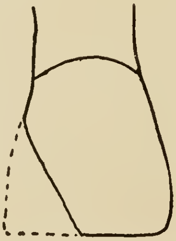


Fig. 14

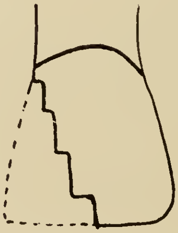


Fig. 15

If the labial wall is thin and lacks sufficient dentin to give it adequate strength, there should be an additional step made inciso-gingivally upon the lingual surface.

This is formed with an inverted cone bur in the right angle and should extend from the incisal step to the gingival seat. The step should be on an average about one and one-half millimeters wide and a corresponding depth. Some authorities advise a groove extending inciso-gingivally along this step, which has advantages in many cases, but care should be taken to consider carefully the location and size of the pulp in live teeth.

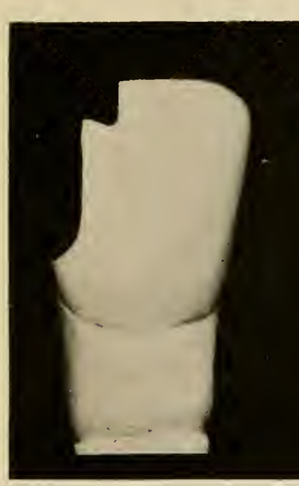


Fig. 16

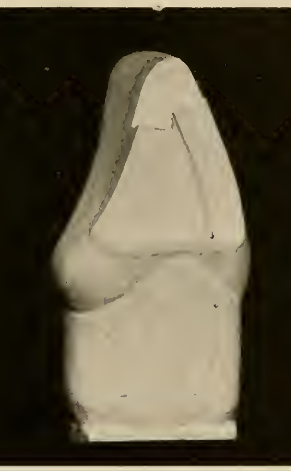


Fig. 17

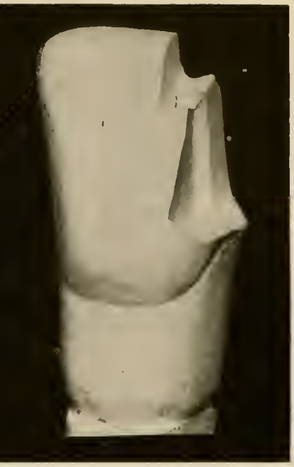


Fig. 18

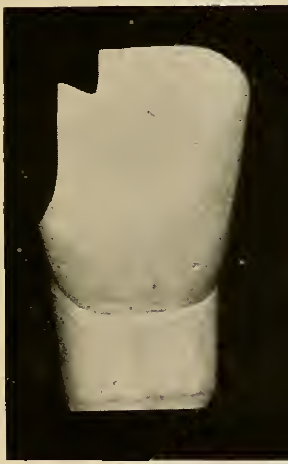


Fig. 19

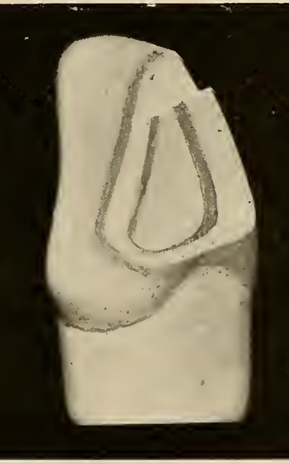


Fig. 20

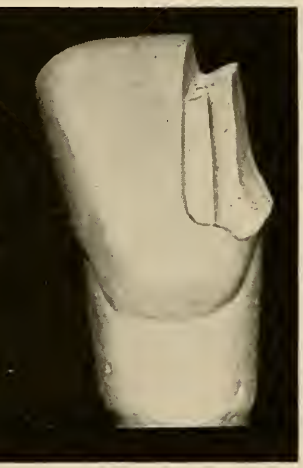


Fig. 21

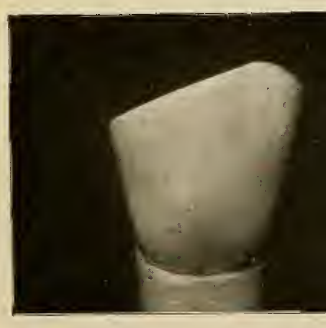


Fig. 22

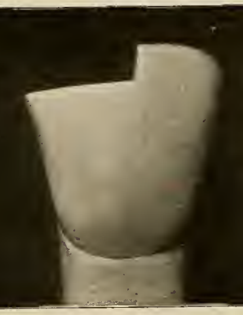


Fig. 23

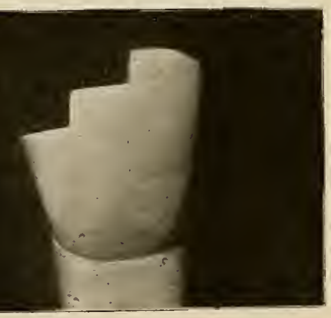


Fig. 24

INCISAL RESTORATIONS

In considering cavities involving the incisal third of the six anterior teeth, it might be well to divide them into two classes: *First,* fractures; *second,* atrophied teeth.

In fractures, the teeth may be broken diagonally or almost at right angles to the long axis of the tooth. In either case, the labial margins should be cut at right angles to the long axis of the tooth. If the break does not involve both angles, as in *Fig. 22,* the margin should be cut away, as shown in *Fig. 23,* or if the fracture is at a greater angle, the surface may be stepped, as in *Fig. 24.* This method of preparation will be much less conspicuous than where the margin is at an angle.

Porcelain "tips" are very disappointing in many cases, especially where they involve the entire incisal edge. We may have a perfect match for the color before cementing, and there may be no apparent change in the color of the porcelain after cementing to place, but the shadow caused by the tip and cement will cause the remaining portion of the tooth to turn dark and be decidedly unsatisfactory during ordinary conversation. If there is an approximal cavity which can be included in the restoration, this trouble does not seem to appear.

In large cases, involving more than the incisal third, it is preferable to follow the method suggested for badly atrophied teeth.

The retention for fracture cavities may be formed by cutting away the dentin to a depth equal to the extent of the fracture, as in *Fig. 25.* This extension for the retention is done with an inverted cone bur, followed with a smooth fissure, and all walls should be parallel to each other.

In cases where there is danger of encroaching upon the pulp by using the above method, the procedure may be reversed, the enamel and a small portion of the dentin removed, as in *Fig. 26.* If these methods do not seem to give sufficient anchorage, or the tooth is broken well up on the lingual, the cavity should be extended sufficiently on the lingual to gain the required retention; *Fig. 27.*

With the exception of very large, thick restorations, pins are contraindicated as they so weaken the porcelain that it is sure to fracture at this point.

In atrophied teeth the labial margins should be extended gingivally sufficiently to reach the normal contour of the tooth; otherwise the inlay will be noticeable. If this extension does not go beyond the incisal third the retention may be formed the same as in fractures. If the defect is in the middle third of the tooth, it is advisable to remove the entire labial surface on account of the objectionable changes of the gingival third. First remove the enamel with carborundum stones, then shape with inverted cone burs, extending it to the free margin of the gums and well to the mesial and distal, *Fig. 28* (mesial) *Fig. 29* (distal). The porcelain should form the contact point with the approximating teeth, otherwise there would be danger of recurrence of decay.

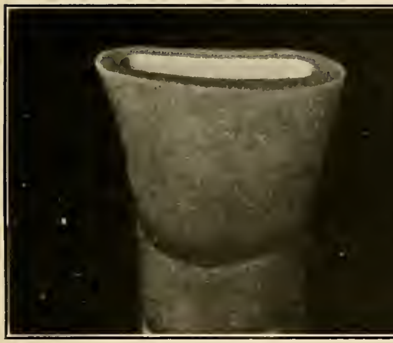


Fig. 25

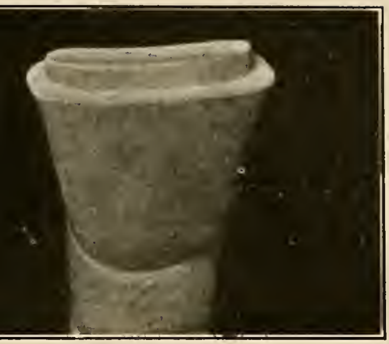


Fig. 26

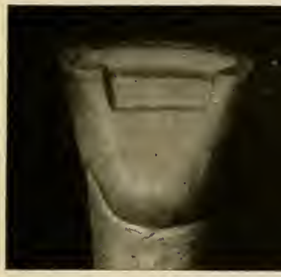


Fig. 27

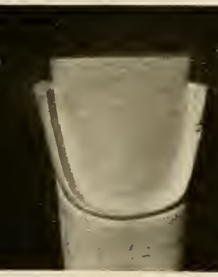


Fig. 28

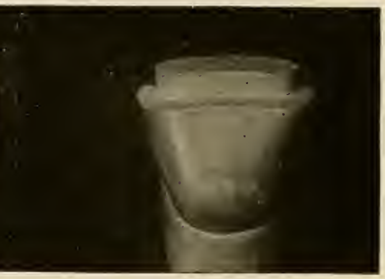


Fig. 29

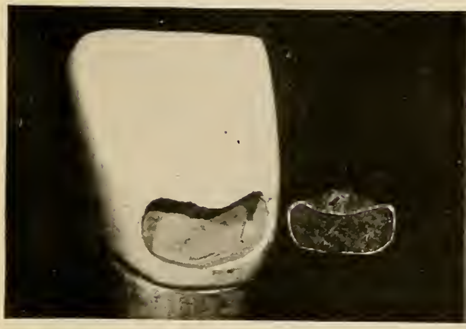


Fig. 30

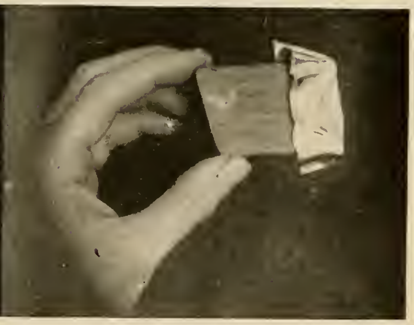


Fig. 31

THE MATRIX

Both platinum and gold foils have their advantage as a matrix material. While gold can be used for only low-fusing porcelains, it has the advantage of close adaptation to the margins of the cavity, thus making a better fitting inlay with less burnishing. It has the disadvantage of becoming very soft when subjected to the heat of the furnace, thus necessitating the careful investing of the matrix before baking. For this reason platinum is becoming more popular daily. There are three thicknesses of platinum foil upon the market ordinarily, 1-1000, 1-1200 and 1-2000. The thicker foils are more commonly used, the 1-1200 being preferable to the 1-1000. This foil is slightly thinner and is sufficiently rigid to withstand the manipulating of the porcelain without changing the shape.

It is not necessary to anneal platinum foil before using. As a rule it is much softer as it comes from the manufacturer than we can possibly make it without subjecting it to high temperatures in the furnace.

GINGIVAL CAVITIES

If we have prepared our cavity after the lines previously suggested it will be found to be very difficult to force the matrix to the bottom of the cavity without tearing. To facilitate matters it is an excellent plan first to shape an orange wood stick to loosely fit the cavity, as shown in *Fig. 30*. Over this the platinum is roughly formed, *Fig. 31*, care being taken to avoid large folds in the foil. If the stick has not been too large the foil will drop to the bottom of the cavity without a bit of pressure having been brought to bear upon the thin foil. Next, place a pellet of moist cotton in the bottom of the matrix thus formed and with one burnisher hold the matrix to place against the floor of the cavity while with the other carefully burnish, starting at the center of the floor and gradually working towards the walls of the cavity. At no time allow the burnisher to touch the platinum, always have an intervening cushion of damp cotton. The matrix should be adapted to every portion of the floor of the cavity before any attempt is made towards the walls and margins. The final burnishing is done along the margins and on the surface of the tooth.

At first thought you would think the folds. formed in shaping the matrix over the stick, would remain in the finished matrix; however, if it is carefully done every one will disappear as the burnishing proceeds.

After the burnishing is completed the matrix should be packed full of camphor gum (Dr. Allen) letting it extend slightly beyond the margins. This will tend to remove any rocking that may be present. After teasing the matrix from the cavity, the camphor may be burned away, leaving the matrix clean and in normal shape.

SIMPLE APPROXIMAL CAVITIES

The orange wood stick is equally of value in these, as it was in the gingival cavities. In the first case the end of the stick was fitted to the cavity, while in this the side is used, as in *Fig. 32*. The platinum

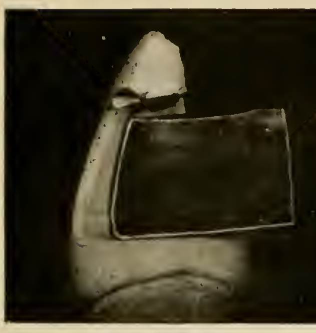


Fig. 32

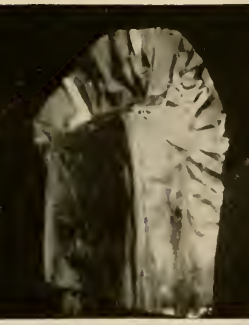


Fig. 33

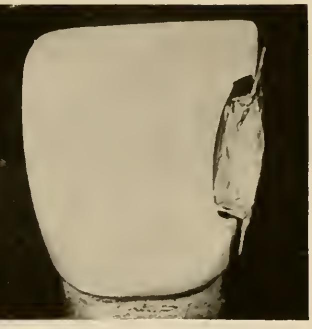


Fig. 34

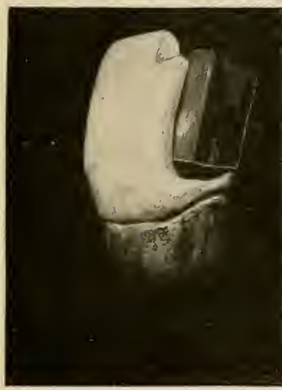


Fig. 35

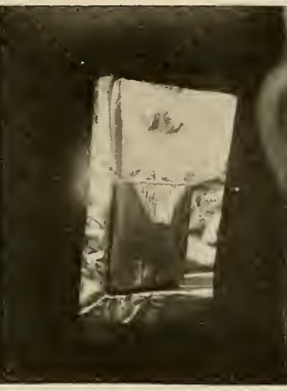


Fig. 36

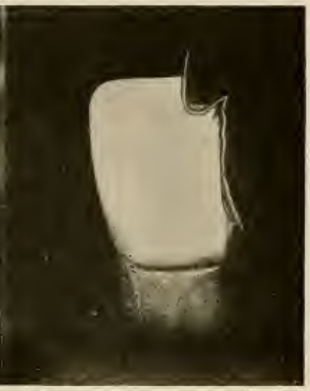


Fig. 37

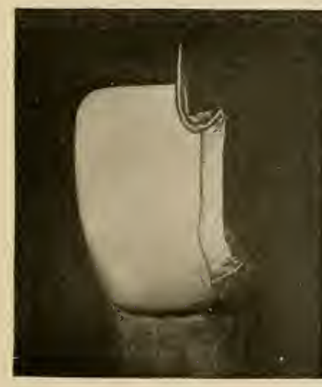


Fig. 38

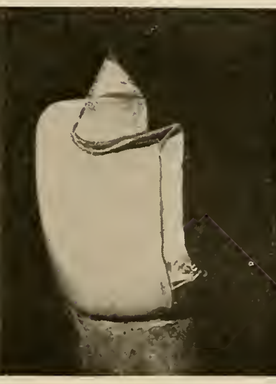


Fig. 39

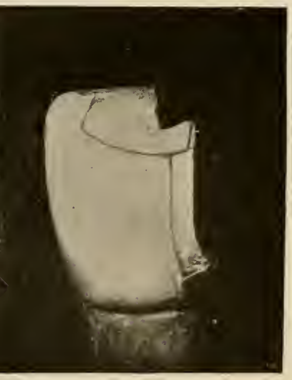


Fig. 40

is shaped over one side, the two edges and the end of the stick, as in *Fig. 33*. On account of the approximating tooth it is necessary to bend the edges of the platinum forming a flange around the matrix. In this manner the matrix readily goes to place even though there is but little separation, *Fig. 34*. The matrix is then filled with damp cotton and burnished to place, starting at the deepest part of the cavity and gradually working towards the margins. After this is accomplished any rocking of the matrix may be removed by stretching damp English twill tape tightly over the matrix, or better still, use a heavy rubber band, stretching this over the entire matrix and burnishing over this sufficiently to bring the platinum finally against the tooth.

If it is necessary to trim the matrix that it may be removed easily, it should be done before the final burnishing, then replaced and burnished, using the rubber band.

CAVITIES INVOLVING THE INCISAL EDGE.

Ordinarily the most difficult matrix to form without tearing is one for step cavities. But by carefully carrying out the following instructions it will be found very simple and in the step where folds are so annoying there will not be a wrinkle.

In shaping the orange wood stick, one side, the end and one edge are used, as in *Fig. 35*. Over this the platinum is shaped, as in *Fig. 36*, again bending the edge of the platinum back in the form of a flange in order that it may pass freely between the teeth.

Place in the cavity and pack with cotton and burnish carefully into the deep portion of the cavity, being careful not to permit the platinum folding over on the labial surface. It should stand perfectly parallel with the labial margin. With a pair of cotton pliers gradually bend the matrix into the step, *Fig. 37*. With a flat burnisher adapt closely to the labial wall and in the step, then with the same burnisher carry the surplus on the labial wall to place, *Fig. 38*. Next carry the approximal portion of the step to place, *Fig. 39*, and finally fold back the portion covering the gingival of the step, *Fig. 40*. This fold in the platinum stops at the cavo-surface angle, consequently it does not interfere with the adaptation of the inlay. Burnish over the lingual margin carefully and use the rubber band as in the preceding case.

EQUIPMENT.

Before taking up the manipulation of the porcelain, I wish to say a word in regard to the necessary equipment:

It will be noticed that very few burnishers were mentioned in the making of the matrix. There are several sets, of from ten to fifteen instruments each, upon the market. These are good, but an unnecessary expense to the man who does not expect to make a specialty of porcelain, and even if he has this in mind, he has discarded all but one or two before he reaches the point to be called a Specialist. The writer seldom uses anything but the S. S. W. amalgam burnishers, Nos. 33 and 34. In these we have two sizes of ball burnishers, two flat burnishers, the edge of which also works very nicely to draw the matrix into the angles of the cavity, and the angle between the ball of the burnisher and the shank makes a very good substitute for the notched burnisher commonly used to burnish over the cavo-surface angle of the cavity. Thus the two instruments are really equivalent to six. Besides the two burnishers, the only instruments used were a pair of locking pliers and a pair of small shears for trimming the matrix.

In buying a supply of porcelain it is well to procure the whole set of colors, even though some of them are seldom used.

The selection of a furnace depends entirely upon the operator's surroundings. If he is located where there is nothing but a night current of electricty, or no current at all, he will have to get along with a gasoline furnace. While, if there is a day current, he should not stop short of an electric furnace with a pyrometer attachment. The time is coming when a man will be just as much out of place with a furnace without a pyrometer as he would be with a vulcanizer without a thermometer.

The proper baking of porcelain should not be underestimated. Many a good inlay has been ruined because the dentist thought he could time his furnace or tell by the glow of the muffle.

If you have no day current you can get very satisfactory results with the use of a device designed by the writer after the suggestion of Dr. Woodbury, of Council Bluffs, Iowa. Obtain a soapstone crayon from a book store or a dealer in metal worker's supplies. Take a piece two and one-half inches long and shape as in *Fig. 41*. At "A" it is simply made smaller to make a more convenient place to get a hold with tongs in putting in and removing from the furnace. From "B" to "D" it is hollowed out about 1-16 of an inch to prevent the gold dropping into the furnace. "C" is a series of small depressions made with a large size cherry bur. These should be as close together as possible without running into each other. "E" is a hole extending almost through the block and is used for holding crowns while baking, nad also acts as a "center" for placing the inlay. As all gasoline mufflers are hotter in the rear than in the front there is a certain point, between "E" and "D," at which the pure gold will melt, exactly the same time that a higher fusing porcelain reaches a proper bake, when placed directly over "E," which is in a hotter portion of the muffle. Pure gold should always be used and by a little experimenting one can regulate his pyrometer by shifting the pellet of gold from one hole to another so that he may get any kind of a bake he desires, from a biscuit to a high glaze. The inlay should be placed at exactly the same spot each time and the slab placed in the muffle exactly the same distance each time. A mica door should be used and the slab and work should

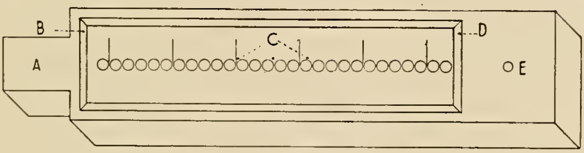


Fig. 41

be removed just as soon as the gold is seen to melt. The same device will work in electric furnaces, but not so well, as the heat is more uniform throughout the muffle.

SELECTING THE COLORS

Many methods have been used in building up the colors for an inlay. A popular method is to select at least three colors, one for the gingival third, one for the middle third, and another for the incisal third.

Although we are dealing with a substance entirely different from the tooth structure, I believe the best results can be obtained only by following Nature's scheme. In this manner there is a gradual shading from the brownish yellow neck to the blue tip.

We will first consider the anatomy of a tooth. From a practical standpoint all dentin (unless artificially stained) is the same color, namely, a brownish yellow, and all enamel is blue. If this one point is remembered by the beginner, three-fourths of his trouble will be eliminated. It is so common to find a man trying to use every color in the outfit, when in reality two or three colors properly applied will meet almost every requirement, except in discolored teeth.

A longitudinal section of a tooth will clearly show the relation of the enamel and dentin, *Figs. 42-43*. It will be noticed that the enamel at the neck is thin and the dentin predominates decidedly, while at the tip the enamel predominates. As the dentin is of a brownish yellow color and there is very little blue enamel covering it in the gingival third, naturally the tooth would have the color of the dentin, while at the tip, where there is practically no dentin, it would take the color of the enamel, and in the middle third, where the dentin and enamel are more nearly equal, we find a composite of the two colors, or a greenish gray.

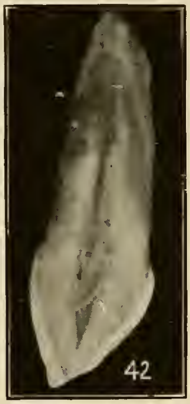


Fig. 42

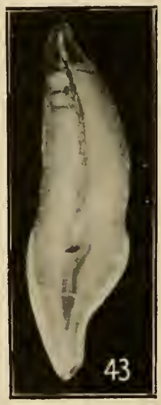


Fig. 43

To prove that it is a difference in quantity of dentin and enamel, and the relative proportions of each that gives us the various shades in teeth, rather than a difference in coloring matter, examine a few of the patients who present themselves. Patient A——, we will say, has a decidedly yellow tooth. On examination we will find the crowns are short and labio-lingually they are very thick, the dentin extending to the cutting edge. *Fig. 42.* Patient B—— has a light blue tooth; here we find a much thinner tooth labio-lingually, *Fig. 43,* the labial and lingual plates of enamel come almost together in the middle third, consequently the tooth is light and receives most of its color from the enamel.

In selecting the color of a tooth, get the shade of the dentin as near the gingival as possible where the enamel is the thinnest, and select the enamel at the very tip, where it is free from dentin. Always cover the shade guide with a finger, except an amount in proportion to the tooth. As a matter of convenience, the series of shades should be grouped together, ranging from light to dark. This makes the selection much easier. The normal dentin colors, in the leading makes of porcelain, ranging from light to dark, are as follows:

White's High Fusing: T, R, P, I, H, J, K.
Brewster's High Fusing:: A, B, C, D, E, F, G, H.
Consolidated High Fusing: B, C, D, I, J, K, L, M.
Whiteley's Inlay Porcelain: 3, 4, 5, 6, 7, 8, 23, 24.
Brewster's Gold Matrix: 1, 2, 3.
Jenkin's Porcelain Enamels: 22, 20, 17, 4, 7, 27, 12.
Brewster's Low Fusing: 1, 2, 3, 4.

The colors of the enamels are:

White's High Fusing: E, C.
Brewster's High Fusing: T; occasionally U.
Consolidated High Fusing: S, T.
Whiteley's Inlay: 13.
Brewster's Gold Matrix: 10.
Jenkin's Porcelain Enamels: 5, 25.
Brewster's Low Fusing: 11.

There is no rule in the selection of colors for discolored teeth. The discoloration is always in the dentin and may be a decided brown or a dark blue, or a combination of the two.

In selecting the color for the dentin we may find the color between two shades upon the ring; if this is the case always select the darker shade—for example, if we were using S.S.W. high-fusing porcelain and find "I" a little light and "H" a little dark, use "H." It is seldom necessary to use more than one shade for reproducing enamel.

APPLYING COLORS

In the high-fusing porcelains it is advisable first to use a porcelain of different density, as the translucency of these porcelains is so great that if we should use the same porcelain throughout, we would have considerable trouble from shadows and cement, changing the color of an inlay. This porcelain, commonly known as foundation body, should be slightly higher fusing and of different refracting properties. It is not necessary, as some think, that this should be of a different color.

On the other hand, better results can be obtained easier by using a foundation body of a color more nearly resembling the dentin.

We will first consider the building of the colors for a gingival cavity. After removing the matrix from the cavity, grasp it in a pair of pliers at some point where there is an excess of platinum.

Take a small portion of the yellow foundation porcelain upon a glass slab and mix with just enough water to make a doughy mass. There should be no excess of moisture standing upon the surface. A good way of knowing when the mix is just right is to pass the edge of the spatula through the mass; if the halves do not flow back together or break in cutting, the proportions of water and porcelain are correct. Take a small amount of the porcelain upon the point of the spatula and place in the bottom of the matrix, then with the gnarled portion of the handle, jar to place. An excess of moisture, or too much jarring, will have a tendency to separate the particles of porcelain, the heavier going to the bottom, leaving lighter on the surface, thus ruining the quality of the finished porcelain. Just as soon as an excess of moisture appears upon the surface it should be removed either by bits of blotting paper or by touching the damp porcelain to the dry powder, then removing any that may stick with a dry camel's hair brush. This foundation porcelain should in no case come to the margins of the cavity, but should be built only to within about a millimeter of the surface, as shown in *Fig. 44*. It is not necessary to use any scheme to direct the shrinkage, such as cutting crosses in the porcelain, varnishing the matrix, etc., as even if the matrix does change, we have an opportunity of reburnishing, as we left all our margins free. This should be baked to a low glaze.

After reburnishing, grasp the matrix in locking pliers and take a small quantity of the porcelain selected to restore the dentin and carefully fill the crevices caused by the shrinkage of the foundation body. Then add enough of the dentin porcelain to reproduce the dentin of the tooth. Great care should be taken in placing this porcelain, as just the right amount of space should be left for the overlying enamels. The dentin porcelain should be carried to the surface at the gingival, receding gradually as the incisal is approached, *Fig. 45*. If the shrinkage is excessive a second bake may be necessary. This should also be baked to a low glaze, and, in fact, every bake until the last, otherwise the porcelain would be overbaked on the finish. Next, restore the enamel with the blue porcelain, *Fig. 46*, never building it beyond the margins, as the amount of shrinkage is very uncertain. If the shrinkage brings the surface below the proper contour, add sufficient to restore the shrinkage.

Do not try to make inlays in a hurry. If a few extra bakes will give a better result, do not try to do it all in one.

The same scheme of building colors, as illustrated for gingival cavities, is used for simple approximal cavities.

In *Fig. 46* you will notice the manner of building up the foundation porcelain. As before, the margins are kept entirely free, thus preventing a change in the matrix in this region and enabling the operator to reburnish if he feels in doubt of his adaptation. *Fig. 47* shows the restoration of the dentin. If the cavity is large and the gingival margin extends to the neck of the tooth, this porcelain is built quite to the surface, receding as it approaches the incisal margin. It will be noticed that both the labial and the lingual surfaces are trimmed away about equally. This was done simply for the pleasing effect if examined on the lingual. However, the writer often thinks it prevents, to a large extent, the change in the inlay, from shadows. It may be necessary to apply this dentin portion the second time to compensate for the shrinkage. On this the enamel porcelain is built, bringing it *just flush* with the margins. This will necessitate a second baking, but it is difficult to judge shrinkage and it also gives one an opportunity of making a slight change in the colors if his first selection was not correct.

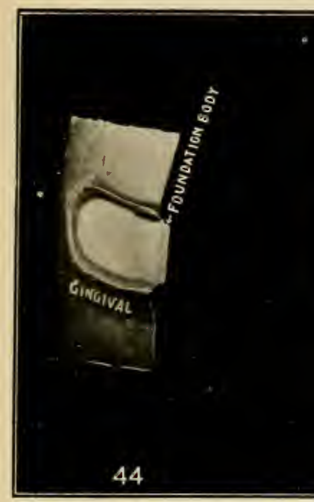


Fig. 44

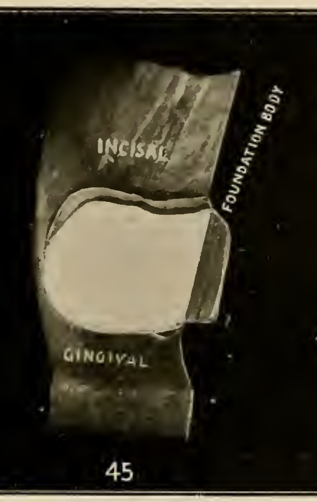


Fig. 45

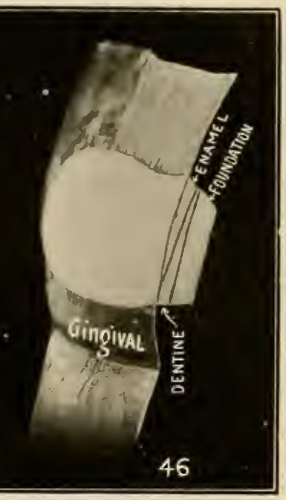


Fig. 46

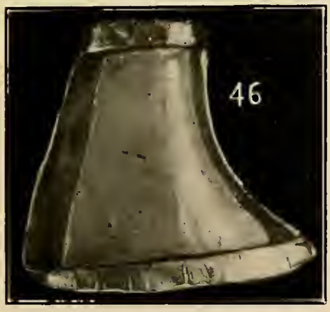


Fig. 46

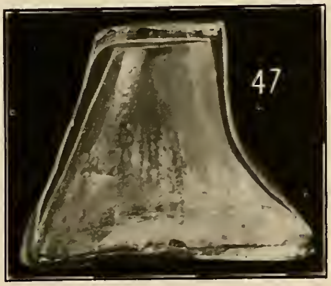


Fig. 47

In cavities of the third class, the foundation body is carried only to within about a millimeter and one-half of the incisal edge. *Fig. 48.* The dentin porcelain may stop about the same point or extend entirely to the cutting edge, depending entirely upon the labio-lingual diameter of the tooth. As a rule we will find it necessary to extend the dentin quite to the surface at the gingival, *Fig. 49,* as we select the dentin where it is modified to a certain extent by the enamel and do not get the true dentin color.

In all cases be particular to restore the contour of the dentin as it originally was in the tooth, *Fig. 50.* The enamel is contoured exactly as you wish the finished inlay and just flush with the margins. Never guess at an excess which will compensate for the shrinkage, as there is no fixed rule regarding the amount of shrinkage and the less we use a stone in finishing our inlay the better the result.

Before taking up the next step, it may be well to mention a few precautions, helps, etc., in the working of the porcelain. Never lay the matrix down, but grasp it in a pair of pliers and lay the pliers so that the inlay will stand out from the edge of the table.

Distilled water is preferable to alcohol for mixing all porcelains, as it evaporates more slowly allowing ample time for carving the porcelain. Do not try to work the porcelain too damp, as it is impossible to build contours, and the porcelain ingredients have a tendency to separate, thus producing a weak product.

It is seldom necessary to mix colors. Get shades by laying one color over another. Never attempt to build in the enamel color without having first baked the dentin color to a low glaze, as the colors will blend and produce an entirely different result. In removing an excess of moisture, the best absorbent is the dry porcelain powder which is being used at the time. Touch the inlay to the dry powder, then brush away the adhering particles with a soft dry camel's hair brush. Never use a damp brush to remove the excess of porcelain on the margins of the matrix; it simply makes a thinner layer of the porcelain and makes it difficult to remove. A better way is to loosen the particles of the body with the point of the carving instrument and brush away with a dry brush. Remember that low fusing porcelains are more nearly opaque than the high fusing, consequently it is necessary to carry the dentin color to the surface of the inlay. Otherwise the enamel color will cut it out completely.

Before baking, always examine the under or cavity surface of the matrix to make sure there has no porcelain run over on that side. If there has, it should be removed before placing in the furnace, as it will be impossible to remove the matrix and will prevent the inlay going to place. Be sure the procelain is entirely dry before placing in the hot furnace. Do not bake too rapidly. A much higher grade of porcelain will be produced by starting with a cool furnace and gradually raising the temperature, using plenty of time to allow the heat to penetrate the body. Placing in a hot furnace or raising the temperature too rapidly will cause a crust to form on the surface and the inner part will be porous.

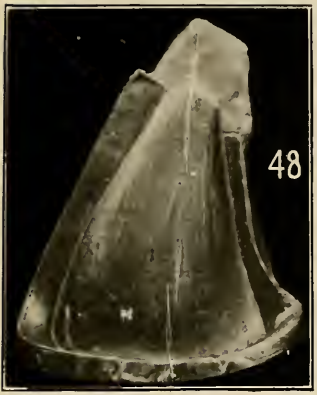


Fig. 48

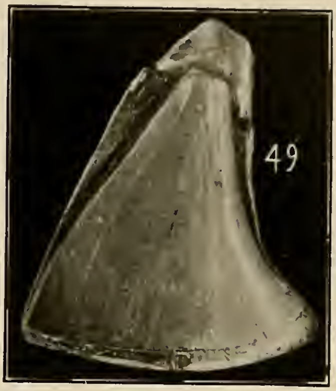


Fig. 49

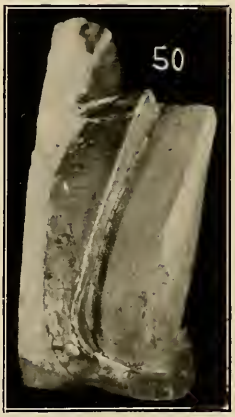


Fig. 50

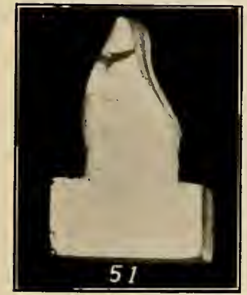


Fig. 51

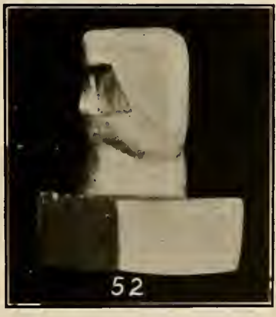


Fig. 52

Do not apply the body in the center of the inlay and expect it to flow to the margins by jarring. It may seem to do this, but at the final bake a row of bubbles will appear along the margins as a result of this. It is better to build all over the surface to a slight excess, then trim down to the desired contour.

REMOVING THE MATRIX

After the inlay has been properly baked, the next step is to remove the matrix. This should be carefully done by grasping the free edge of the platinum in a pair of pliers and peeling toward the center. This may be more easily accomplished by first dipping the inlay in water.

After removing the matrix the cavity surface of the inlay must be roughened to permit the cement to properly adhere. This may best be accomplished by imbedding the inlay in wax, leaving only the cavity surface exposed, and etch with hydrofluoric acid. It should be left in the acid from two to five mintues, depending upon the porcelain and the strength of the acid. This is very important and should not be neglected. A simple gingival inlay with four antagonizing walls will not hold if it is not properly roughened.

The acid should be thoroughly removed by washing, using a fine, stiff brush.

SETTING THE INLAY

The so-called "Cement Problem" has confronted the porcelain worker for years. A great deal of the change in color, on cementing an inlay to place, is due to a too thick layer of cement between the inlay and the cavity. This may be due to lack of adaptation of the inlay, using cement so thick that the inlay fails to go to place, or having a cement that is so coarsely ground that it will not permit the inlay going to place. The color of the cement has little to do with it, a light cement being nearly as bad as a dark under similar circumstances. Thin layers of cement will transmit light; therefore, if we expect our inlays to retain their color after setting, we must have our adaptation so perfect that the layer of cement will be thin enough to transmit light.

No cement should be used except one which is especially ground for inlay purposes. The writer prefers a cement pearl gray in color. This should be carefully mixed to a creamy consistency, being careful that there is sufficient powder to take up all the free acid. This should be spread over the dry cavity with an explorer, using as nearly as possible the exact amount necessary. Force the inlay to place and keep under pressure until the cement sets. If the work has been properly done there should be little or no grinding to do after the inlay sets.

GOLD INLAYS

Probably nothing ever introduced into dentistry was so universally taken up and created such wild enthusiasm as did the gold inlay, when Dr. Taggart introduced the casting process. There was scarcely a practitioner, no matter from how remote a corner of the land he came, who had not adopted the process within the year. And today, alas, how expensive this wild rush has been to many a man's practice. Undoubtedly greater care is needed in making a gold inlay than ever was called for in porcelain restorations. The difficulty in thoroughly roughening the gold to insure perfect adhesion of the cement, necessitates a careful consideration of mechanical retention in the cavity.

Although the casting process has decided advantages in most cases, there are certain cases when the old method of burnishing a matrix is preferable. While in others a combination of the two will produce the best results.

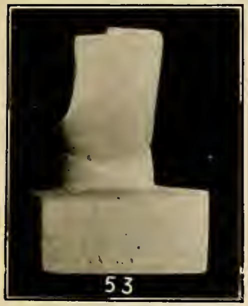


Fig. 53

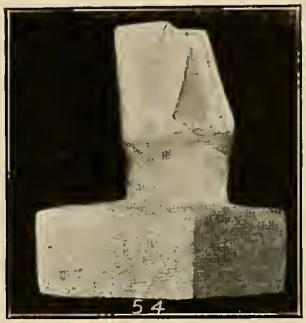


Fig. 54

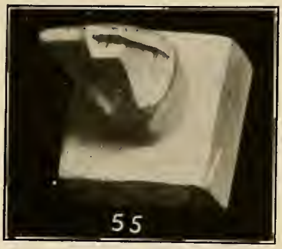


Fig. 55

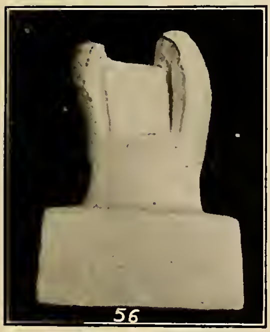


Fig. 56

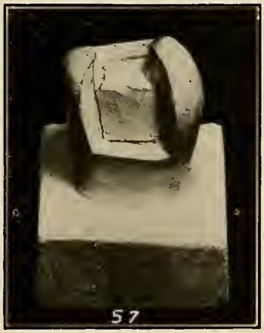


Fig. 57

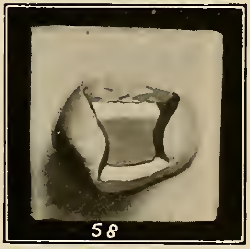


Fig. 58

In small cavities with four walls, much time can be saved and an equally good inlay made by burnishing a matrix of platinum and filling with pure gold. In cases of large size where it is difficult to remove the wax without impairing the margins, a combination of a pure gold matrix and the remainder cast, is indicated.

STUDY THE OCCLUSION

Before starting the preparation of a cavity for a gold inlay a careful consideration of the occlusion must be made. A cavity must have a resistance form to antagonize all stress upon the inlay or it will surely be dislodged. Have the patient move the jaws laterally and notice the stress in this direction, then mesio-distally, as well as at rest. Many peculiar conditions are brought out by doing this, which may completely change the nature of the cavity preparation.

CAVITY PREPARATION

Simple Approximal Cavities

The general outline of a cavity for a gold inlay for simple cavities is very similar to that given for porcelain. In cases where the occlusion is normal, the lingual wall should be cut away to permit the removal of the wax pattern or matrix, in that direction. The incisal and gingival walls should be parallel to each other mesio distally and there should be a decided seat under the labial wall. The incisal and gingival walls should diverge slightly from labial to lingual, to permit the removal of the pattern.

The technic of the operation consists of, first, breaking down any thin enamel margins and cutting away the lingual wall with chisels, always remembering that unless enamel has an underlying support of dentin, it is worthless and should be removed. Next, with a smooth square-end fissure bur in a right angle, entering from the lingual, extend the gingival margin sufficiently to permit the removal of the pattern. Form the incisal wall in the same manner, and with the square end of the bur cut the seat under the labial wall. Then, with hatchet and hoe excavators make a definite angle at the junction of the incisal, gingival and labial walls with the axial. In very deep cavities it is well to build in with cement, care being taken not to carry it to an extreme. All margins should be smooth and slightly beveled.

CAVITIES INVOLVING THE INCISAL ANGLE

In this class of cavities it is preferable to use a step for incisal retention. In cutting this, fine grit carborundum stones are used, extending it sufficiently laterally to permit making a pit in perfectly sound dentin. On the labial, only sufficient should be cut away to give the enamel a protection of gold. Much less cutting is necessary as compared with that for a gold filling.

The lingual wall of the step should be cut away to permit good anchorage in dentin. At the end of the step should be a well-defined pit.

The body of the cavity is prepared much the same as that for porcelain, cutting away the lingual to permit the easy removal of the pattern. The gingival wall should be flat and there should be a flat seat under the labial plate. In deep cavities the axial wall may be built out with cement, care being taken that all margins are freed from cement before the impression is taken.

CAVITIES IN BICUSPIDS AND MOLARS

The ideal place for gold inlays is in the bicuspids and molars. They eliminate the great difficulty of placing cohesive gold in inaccessible cavities and have greater strength. Within a very short time the inlay will almost take the place of the gold crown. The misfitting band and inflamed gum will be a thing of the past.

In all proximal cavities in bicuspids and molars there should be a step including all fissures on the occlusal surface.

Figs. 56, 57 and *58* represent a cavity in the bicuspid. In the proximal portion there should be a flat gingival seat, the buccal and lingual walls should be as near parallel to each other as possible and permit the removal of the impression. The occlusal portion should be of sufficient width and depth to give strength to the inlay and should terminate in a definite dove-tail which affords retention from dislodgment approximately. In badly-decayed teeth, the cavity should be built out with cement, to within a millimeter and a half of the surface. This will give sufficient bulk of gold and will make the inlay of better retention form.

In larger cases, especially where both mesial and distal surfaces are involved, and the buccal and lingual walls are weak, the cusps should be removed and the tip restored with gold.

Molar cavities, *Fig. 59,* are prepared along the same lines, making an occlusal step extending into all the deeper fissures. The pulpal and gingival walls should be flat and at right angles to stress. The buccal and lingual walls should be as near parallel to each other as possible and permit the removal of the pattern.

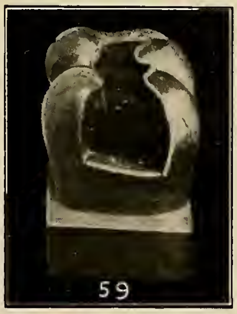


Fig. 59

All the above cavities are for the restoration of lost tooth structure, and are not intended to carry lost teeth in bridge work. The cavities following are intended more especially for use in bridge work and the retention of teeth.

GOLD INLAYS FOR BRIDGE ABUTMENTS

The casting process opens a field in bridge work of inestimable value. In the past many teeth have been multiated for the construction of bridge work, which in the future will be saved almost in their entirely with the use of inlays. We have all experienced the difficulty of properly shaping molars and biscuspids to permit a close fitting shell crown. While in the anterior teeth it necessitated the use of a shell crown or the entire destruction of the crown of the tooth for a Richmond crown to permit of bridge work. With inlays a much more sanitary and an equally strong anchorage may be made.

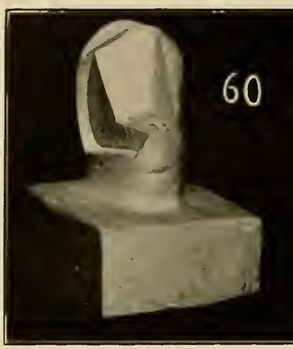


Fig. 60

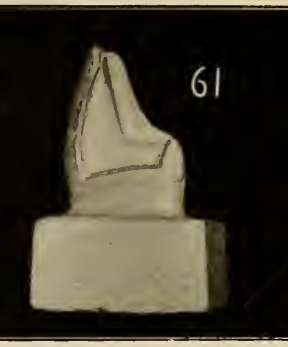


Fig. 61

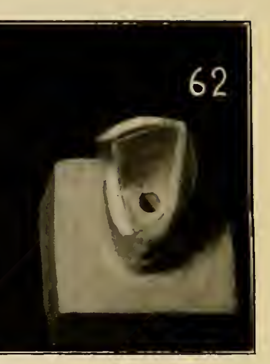


Fig. 62

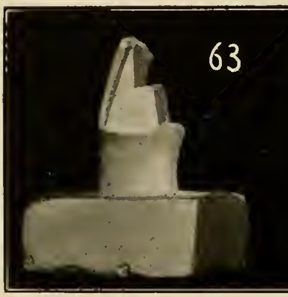


Fig. 63

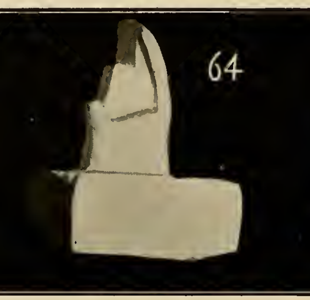


Fig. 64

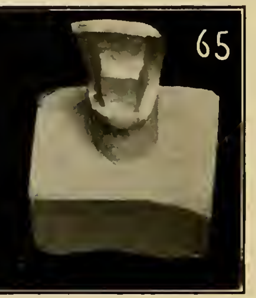


Fig. 65

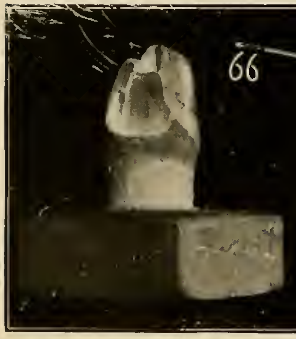


Fig. 66

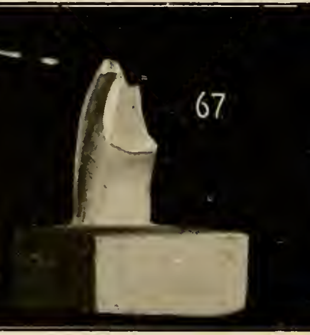


Fig. 67

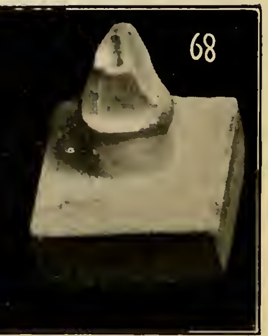


Fig. 68

It is a system, however, that will necessitate the greatest care on the part of the operator in regard to every detail in the preparation of the cavity adaptation of the inlay and attachment of the dummies.

In preparing a cavity for an abutment we should *examine* the *occlusion* minutely and make a careful estimate of the stress that will be brought to bear upon the restoration. Always bear in mind that there is a certain amount of movement of teeth in their sockets and that the movement may not be equal at both ends of the bridge; hence unless we have an absolute mechanical anchorage the inlay will surely be dislodged.

We will first consider the prepartion of a cavity in a cuspid. In most cases it is advisable to devitalize and use an iridio-platinum pin as anchorage. After having removed the pulp and filled the canals, take a carborundum stone and remove the approximo-lingual angle. Then with inverted cone burs extend the proximal portion well to the gingival, *Figs. 60, 61, 62,* making a flat gingival seat. The approximal portion of the cavity should be extended labially sufficiently to make the labial margin perfectly self-cleansing and at the same time not so far as to show the gold appreciably. The pulpal wall of the main portion of the cavity should be made flat and at right angles to the long axis of the tooth. The incisal edge should be cut away sufficiently to permit its restoration with gold. In no case should the labial plate be left standing without this protection. All margins should be at right angles to the surface of the tooth with a silght bevel of the outer third of the enamel. The root canal should be enlarged to admit a 16-gauge iridio-platinum bar and be of a depth equal at least the length of the crown of the tooth.

In cases for small bridges a staple inlay may be used without the necessity of devitalizing, as *Figs. 63, 64, 65.* The lingual plate of enamel is removed with carborundum stones entirely to the incisal. Each approximal surface is prepared similar to that described above. Then with inverted cone burs make the lingual wall flat and at right angles to the surface. At the junction of the middle and incisal thirds a step is formed with an inverted cone bur. The cavity should be extended to, and include, the incisal edge, which should be restored with gold.

Figs. 66, 67 and *68* represent a lateral incisor with an approximal preparation for bridge anchorage. In this case the cavity is stepped on the incisal and an 18-gauge iridio-platinum pin extends into the canal from the step. In all cases the important points are: *First,* extend the cavity to self-cleansing areas; *second,* obtain a thorough resistance form, and, *third,* procure positive anchorage from all stress.

In bicuspids and molars there should be post anchorage in badly broken-down cases. Where the greater part of the tooth is intact, the cavities should include both mesial and distal surfaces extending well to the gingival on both approximal surfaces. *Fig. 69.*

Figs. 70 and *71* show a badly broken-down molar with the pulp chamber built out with cement. In these cases it is important to have flat gingival seats with sufficient breadth to withstand stress. All the cusps should be ground away sufficiently to protect them with gold.

FORMING THE MATRIX OR PATTERN

In small approximal, pit, gingival and occlusal cavities, it is much easier and quicker many times to use the old method of forming a platinum matrix and filling with pure gold, rather than the new method of casting.

We will take for example a gingival cavity. Here we have the secretions of the mouth to annoy us, as well as the close proximity of the gum margin. The wax has a tendency to crumble under moisture and again it is difficult to remove the wax when the cavity extends beneath the gum. In simple approximal and small occlusal cavities it is a comparatively simple matter to burnish a matrix; within a very few minutes it may be filled with gold and ready for cementing to place and finish.

The method preferred would be to form an orange wood stick to loosely fit the cavity, over this shape a piece of 1-1000 platinum foil as described for a porcelain inlay (*Figs. 30, 31*). Remove the matrix and place in the cavity and burnish to place, being careful to spread over the floor of the cavity first, then gradually over the walls and margins. The excess may be trimmed almost entirely away along the gingival margins if the gum interferes. Remove from the cavity, heat in a flame until all carbon has been burned off, cool and coat the surface next to the cavity with a thin solution of chalk in alcohol. Great care should be used in applying the chalk, not to permit any to run into the matrix, as it will cause no end of trouble in melting the pure gold. Allow the alcohol to evaporate, then place the matrix upon a soldering block and fill about one-half with pure gold. Do not use flux, as it is unnecessary and causes pits in the inlay. Immediately drop the matrix into nitric acid which will remove the chalk. Place in the cavity and reburnish. Unless the inlay is large the second time the gold may extend to the surface. After cleaning in nitric acid, roughen the surface with a small bur and cement to place. Before the cement starts to

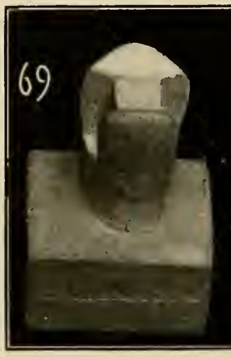


Fig. 69

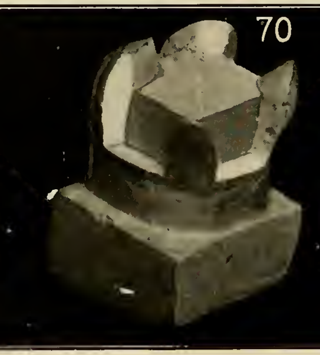


Fig. 70

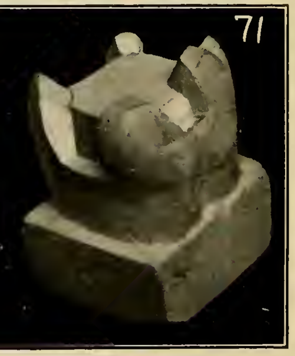


Fig. 71

crystallize, burnish all margins carefully. Then finish the same as a filling. If there are small tears in the bottom of the matrix there will be no danger of the gold flowing through, if the cavity surface is carefully coated with the chalk.

In large contour cases the preferable method is to use the casting process. When this method was introduced, it seemed so easy and simple that the majority of men rushed at it with little thought of what the probable outcome would be. There is no operation in dentistry more difficult than properly removing and investing a wax pattern. This may seem a strange statement but it is true, nevertheless. In the first place the cavity should be so prepared with parallel walls that there is a certain amount of frictional retention and if this is done there is considerable danger of distorting the pattern in removing.

When it comes to investing the pattern there is great danger of changing its shape.

THE WAX PATTERN

In considering this step in inlay construction. it is important that we first consider the material we are to work with. There have been almost as many makes of wax thrust upon the profession as there have been casting machines, and the majority are absolutely worthless. The fact of the matter is, our best base plate waxes are far superior to the majority of inlay wax offered for sale.

The important feature in an inlay wax is to have one with the least possible amount of inorganic material present. In other words, one that can be completely destroyed by moderate heat. The next essentials are, tenacity. close grain and rigidity when cool. The ideal wax should be one that could be softened and formed in a cone with dry heat and when soft should work like chewing gum. When forced into the cavity it should not crack or crumble, but mold to any form desired, either with the use of the fingers or instruments. After chilling, it should carve easily and take on a high polish.

When making the wax pattern, the tooth should be slightly moist to prevent the wax sticking. Warm the wax until it is like putty, shape in the from of a cone and force into the cavity with the thumb and finger, compressing the wax as much as possible with the fingers to insure perfect adaptation to the walls of the cavity. In approximal cavities an excellent plan is to use a heavy piece of dam, placing it between the teeth, first allowing it to rest against the approximating tooth until the wax is forced into the cavity, then with considerable tension upon the rubber, force the wax to place in the cavity. With flat burnisher, working from the center of the cavity towards the margins, work down smooth and at the same time remove the excess. The wax should be as nearly as possible the exact contour desired in the finished inlay, having no more of an excess over the margins than the thickness of paper. After getting as smooth as possible with the burnisher, polish with a pellet of cotton or a soft tape passed between the teeth.

Great care should be used in the removal of the pattern. It is best not to attempt the insertion of the sprue until the pattern has been removed, as many times it would be impossible to attach at the most advantageous point. With gentle pressure upon the labial and lingual surface, using a small pellet of cotton in the cotton pliers, loosen the pattern. The greatest care should be used in its handling after it has been dislodged, as the margins are thin and easily bent out of place. A very convenient receptacle to allow the pattern to drop onto, from the cavity, is a large-size mouth mirror frame, one that has the glass broken away and replace with a thin layer of cotton. As soon as removed, the sprue should be attached and the pattern covered with a thin layer of investment and should never be permitted to lie around, even in water, for some future time to invest.

In bicuspids and molars after forcing the wax to place in the cavity, have the patient close his teeth and move the jaws laterally, in order that the occlusal surface may be as nearly perfect as possible. After trimming down the approximal portion and smoothing as much as possible, have the patient close again to make sure the wax has not been misplaced in the smoothing process.

A careful examination of normally occluding teeth will show the fissures and sulci of the tooth extend deeper than the tip of the occluding tooth. So we should carve the fissures slightly deeper than the impression made by the occluding tooth. A very good tool for this purpose is a small pointed lancet, or in many cases the ordinary hook scaler is excellent. After shaping the occlusal surface the occlusion should be again tested to make sure the wax was not misplaced in carving.

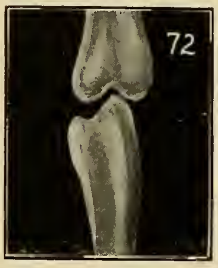


Fig. 72

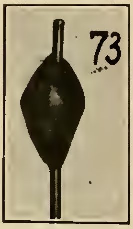


Fig. 73

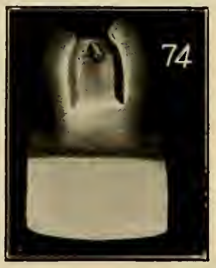


Fig. 74

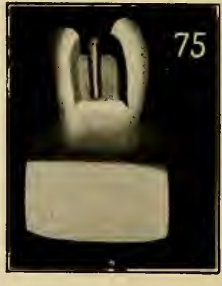


Fig. 75

At this point it might be well to mention the use of iridio-platinum pins as anchorage. In many cases it is not only difficult to get the wax into the pits but it is uncertain about their casting and lack of strength when cast, so a much better method is the use of pins. An iridio-platinum wire, about 20 gauge, is preferable for incisal anchorage, and 16 gauge for anchoring single inlays in root canals. If the inlay is to be used for bridge retention. 14 gauge sprue wire should be used. In getting the pattern for an inlay where 20 gauge wire is to be used for incisal retention, it is best to force the wax home in the cavity first, then heat the pin slightly and push it through the wax into the pit.

In using pins in the canals, it is better to shape the wax in a cone around the pin before inserting into the cavity, having first shaped and bent the pin to conform to the cavity and canal.

In an inlay to be used as an abutment for a bridge, a square 14 or 16 gauge iridio-platinum pin should be used. The pin should extend into the canal at least the length of the crown of the tooth, and should be bent at right angles and extend beyond the contour of the tooth sufficiently to insure thorough union with the dummies of the bridge.

The writer does not believe a soldered union direct with an inlay is good practice. In the first place our solders lack strength and consequently in order to get sufficient strength it is necessary to use such a large quantity of solder that we have destroyed our self-cleansing margins. By using the heavy iridio-platinum union, all margins can be made self-cleansing without weakening the bridge. If we are using a vital tooth as an abutment, it is a question in the writer's mind if it is good practice to attach the inlay direct to the bridge, unless the extension is very large. A simple approximo-occlusal cavity in a bicuspid should never be used in this way. If the cavity is a mesio-occluso-distal, it may prove satisfactory, but the inlay should always be constructed with the use of an iridio-platinum wire, as shown in *Fig. 75*.

If a simple approximo-occlusal inlay is used for anchorage it is not well to make a solid union to the bridge, but instead, the iridio-platinum bar should rest within a tube and set in the inlay. This is easily formed by shaping a piece of platinum plate over the wire to be used, and this set in the wax in the region of the contact point. This method allows a certain amount of movement which is always present during mastication, and prevents dislodgment of the inlay.

In attaching the sprue, care should be taken to attach at such a point that the gold will be forced as near as possible towards all margins of the inlay. If this precaution is taken the defects, if any, will not be at the margins but some place upon the surface of the inlay where it can be more easily repaired.

INVESTMENTS AND INVESTING

This particular phase of inlay work does not receive the attention it should. In the first place the wax pattern should be so carefully made and polished over the surface that it is without a flaw; then secondly, it should be invested with an investing material that will conform to the pattern and produce a casting as perfect as the original pattern. Our neglect lies in using a too coarse investment and the careless manner of applying it.

It is preferable to use a fine investment first, one which is easily painted over the surface of the pattern and later invest in the cup with a coarser, more substantial material. An excellent preparation for first coating the pattern is equal parts powdered rouge and plaster, while there seems to be nothing better than equal parts of extra fine powdered silex and plaster for the outer investment. If these investments are prepared by the dentist. he should be carful about thoroughly mixing the ingredients, otherwise the investment will crack and shrink. It should be passed through a fine sieve at least five times.

After removing the wax pattern from the cavity and attaching the sprue wire, examine very carefully, and if there is any collection of saliva or blood, the pattern should be thoroughly cleaned, first, in a stream of water from a water syringe. then wiped carefully with a brush or pledget of cotton, moistened in alcohol. Attach the sprue wire to crucible former and we are ready to invest.

Mix a small teaspoonful of the red investment with water until it is the consistency of thick cream, then with a small camel's hair brush paint the surface of the pattern carefully, making the first application very thin and be particular about working it into every minute angle. Gradually build up with this investment until there is a thickness of at least 1-8 inch over the entire pattern. This investment should extend down over the sprue wire and crucible former, otherwise there might be a slight crack between the fine and the coarse investments, which would fill with gold and possibly destroy the value of the inlay.

After the fine investment has set, nearly fill the cup, if you are using that style of receptacle, with the coarser investment and invest the pattern and sprue and with gentle jarring settle to place. If a ring is being used, set it over the inlay and fill with the investment, being careful to work into every minute crevice and irregularity of the first investment.

After the investment has set, the ring should be placed over a slow fire to dry. It is perferable to have the investment heat slowly, as there is less danger of a change. The heat should be gradually increased until the investment is a dull red to the center, when it is ready for casting.

PREPARATION OF GOLD

It is very important to have our gold for casting free from all foreign matter before placing it in the crucible to be cast. If we have been particular with the treatment of the wax pattern previous to this time and it is a perfect counterpart of our cavity, very little burnishing of the margins is necessary. Consequently it is possible to use our scrap plate rather than pure gold. If we have been reasonably careful with our scrap, kept it free from platinum or silver, the color is not bad for fillings and it has the advantage of retaining its shape better than pure gold.

If scrap is used, it should first be boiled in 50% nitric acid to remove any base metals that may be present, wash and place upon a charcoal block and melt. While the mass is in a molten condition it should be sprinkled with Ammonium Chlorid (Sal Ammoniac). This should be repeated until the gold ripples like water. This may be remelted in a carbon crucible and cast into ingots for use or used as it is.

If we are melting our gold in a crucible formed in the investment very little flux, if any, should be used, as there is danger of its closing the opening into the mold, thus preventing a perfect cast, if the gold goes down at all.

The importance of having our gold in perfect condition for casting must not be overlooked.

It is hardly necessary to mention machines for casting, as there are so many and all will get results if properly handled. Some require a little more care than others, but good inlays may be had in any. from a tin can lined with wet asbestos to the most complicated machines. I think, however, the centrifugal principle among inexperienced college students, will give the most uniform results.

After the inlay is cast it should be washed thoroughly to remove all investment attached, then placed in Hydrofluoric Acid, which will remove any fused silex. The sprue should then be carefully cut off and the cavity surface examined minutely for any small bubbles of gold that may be attached. If the red investment was painted on very thin at first there will be little trouble in this respect.

If there is any difficulty in getting the inlay seated in the cavity, an excellent method is to heat the inlay slightly and apply a very slight layer of mercury to the surface; this will unite with the gold and. upon evaporating away with increased heat, the gold will be left with a frosted surface. If the inlay is now placed in the cavity any point that may rub against the walls will become burnished and can be cut away. When the inlay goes to place perfectly, the surface should again be etched for the better adhesion of the cement.

All inacccessible surfaces of the inlay should be trimmed and polished before setting. However, if it is possible to reach the margin with a burnisher, it should be left slightly flush to permit a thorough burnishing before the cement sets, after which the margins should be finished and polished the same as for a gold filling.

AMALGAM BASE FOR GOLD INLAYS

BY STEELE F. GILMORE, D.D.S., INDIANAPOLIS, IND.

In deep-lying approximal cavities that are inaccessible (such as are distal cavities in molars and bicuspids) rendering the adaptation of the wax model and its gold replica to the cervical border uncertain, resulting in secondary or recurrent decay at this point, this method is indicated.

Technic: After the preliminary opening of the cavity in a gross way, apply the Ivory band matrix, and with it in place excavate the cavity floor with right angle burs. The matrix acting as a guide to your instruments prevents them from slipping into the soft parts, causing unnecessary pain and irreparable damage to the delicate tissues occupying the interdental space. If you are satisfied with the preparation of the cavity floor, together with its buccal and lingual walls, remove the matrix and carefully stone the margin. Now if the approximal surface of the neck of the tooth is irregular(concave, for instance) you can, with pliers, so swage and manipulate this soft steel as to adapt it accurately to the surface above mentioned. Properly mixed amalgam, in *very* small pellets, may now be vigorously burnished in and built up as far as your judgment may dictate. Insert temporary stopping until the next sitting, when complete preparation of the occlusal surface can be made. Or a quick setting amalgam may be used and the model obtained at the first sitting.

Advantage: A perfect adaptation, without any of the elements of guess work in this dark corner. The surface alignment of your filling is automatically provided for at the cervical margin. To the delight of the patient, approximal trimmers and burnishers are not needed. You have re-inforced the weak point of all inlays. There can be no electrical disturbance, since the two metals are insulated by the intervening cement.

SOME PLACES WHERE THE CASTING PROCESS HAS BEEN FOUND USEFUL.

BY E. T. TINKER, D.D.S., MINNEAPOLIS, MINN.

In the following article it will be my endeavor to give you a few applications of the casting process.

The first of which will be a method of casting a coping for a Richmond or Porcelain crown, where it is necessary to reproduce the entire enamel margin, as in cases of split roots, roots that have been supporting crowns and through improper preparation are causing gingivitis, as well as many other cases that may come under our care.

CASTING A COPING FOR RICHMOND OR PORCELAIN CROWN

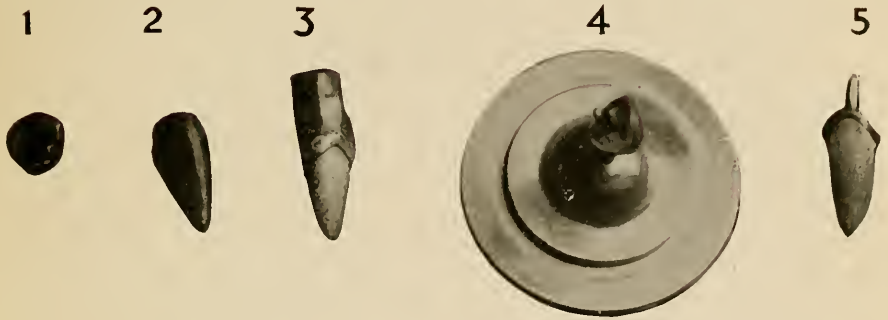
In brief, the procedure is as follows:

Before removing all the enamel and beveling the root, take the measure and make band of 22k.-30g. gold plate. contouring and roughly fitting same (*Fig. 1*). Prepare the root as in *Fig. 2;* place the band in position and force softened casting wax to place (*Fig. 3*). The band being slightly larger than the root acts as a matrix, forcing the wax in direct contact; the free margin of the gum determines the depth to which it shall go. Trim away all surplus wax, warm an iridio-platinum pin and force through wax into the canal, attach the sprue and remove band, wax and post intact, mounting same on crucible former (*Fig. 4*) and cast. By the aid of stones and disks, dress down and polish. leaving a finished coping (*Fig. 5*),which is very strong and one to which the gums take kindly.

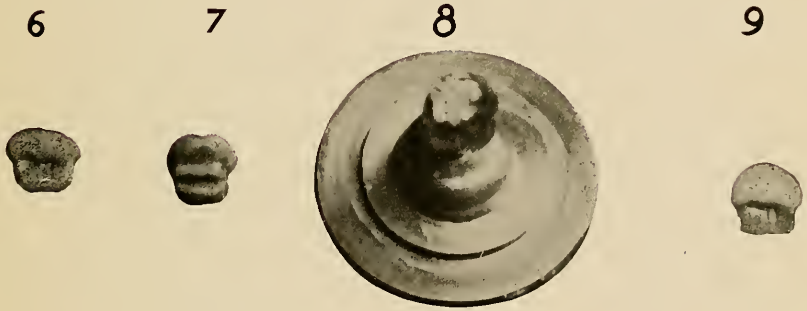
I was very much interested in reading Doctor Kabell's article in the May number of *Items of Interest*, from the fact that it brought out the same difficulty which some of my friends as well as myself have been having with the shrinkage of gold when cast.

TIN FOIL TO CONTROL SHRINKAGE IN CASTING

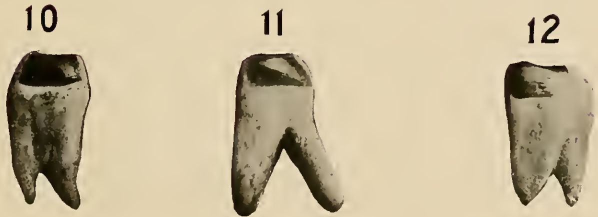
Through the courtesy of Doctor H. A. Knight, I will give you his method of using tin foil to control the shrinkage in casting boxes for porcelain biscuspids and molars when used as dummies for bridge work. Take a common pin tooth, molar or bicuspid, cut off the pins and grind it, as shown in *Figs. 6* and *7; Fig. 6* showing it from the occlusal and *Fig. 7* from the gingival point of view. Take a sheet of casting wax and adapt some very thin tin foil over one side of it. Warm the wax and press to place, having the tin foil next to the ground surface of the tooth and carve as you wish the finished piece.



Figs. 1, 2, 3, 4 and 5



Figs. 6, 7, 8 and 9



Figs. 10, 11 and 12

Attach the sprue in some convenient place, chill, and using sprue as a handle, remove wax and foil from the tooth; chill again and with a pair of small pliers grasp the foil by some small projection and separate from the wax (*Fig. 8*), being careful not to distort wax form, invest and cast. The space gained by the foil will just about compensate for the shrinkage of the gold, the tooth slipping to place without further grinding (*Fig. 9*).

GINGIVAL MARGIN RESTORATION

Another place where difficulty is often encountered is at the gingival margins in large MOD inlays. Doctor F. B. Kremer, of this city, suggested that in cases where we have an otherwise perfect inlay, that we grind away a part of the defective margin (*Fig. 10*), placing a little inlay wax and forcing inlay home over it (*Fig. 11*). Remove inlay and wax intact for casting anew, which gives a very good result (*Fig. 12*). This idea has been carried out in a good many different ways, for instance where a margin of a cavity containing an otherwise good inlay has become fractured, or where a root has become affected by caries under a well-made Richmond, the defective parts of tooth can be prepared, wax placed over them and the old work pressed to place, removed intact and cast, producing practically a new piece of work. Numerous other conditions will present themselves to which this idea can be applied advantageously.

CAST GOLD CROWN

For contact, contour, occlusion and perfect relation to the root and gums, the gold crown made by the following method comes as near the ideal for posterior teeth as anything I have as yet found. Prepare the root along the accepted lines, construct a gold band of 22k.-30g. plate and accurately adjust to the root and gingival, paying no attention to contour as that will be taken care of later. Obtain a bite of occluding teeth in wax and an impression of band and teeth mesially and distally in plaster. Remove band and place it in impression. Make models and mount on an anatomical articulator, oil all plaster adjacent to band, place warm casting wax in band and close the articulator, giving it a lateral motion as in mastication, so as to produce a correct occlusion, and carve. With a camel's hair brush paint melted wax on exterior of band, carve contact points and contour. Remove from model invest and cast and when finished it will be found as near anatomically correct as any which have so far been made, and its one great advantage lies in the fact that by not contouring the band, we do not take the risk of disturbing its relation to the root, the perfection of which we are all aware is the cardinal point in the construction of any crown, the health of the surrounding tissues and the life of the operation depending almost wholly upon it.

TO OVERCOME WEAKNESS OF A CAST GOLD BRIDGE

BY W. J. MONTGOMERY, CHICAGO, ILL.

The brittleness of a cast gold bridge, due to the gold having been melted several times, may be overcome by sprinkling mercury bichlorid over the molten gold immediately before casting.—*Dental Brief.*

CAST GOLD SPLINTS FOR PYORRHEA

BY DR. J. G. LANE, PHILADELPHIA, PA.

Showing more particularly a method of uniting the two plates of the splint and the technic of making up the uniting medium.

Fig. 1. Finished splint in position. The two plates fastened together by means of iridio-platinum screws.

Fig. 2. Pattern for one plate of splint, showing graphite rods in position to core the hole for the screws. In order to get the proper lineup for the cores they are placed in wax pattern before the latter is removed from the model.

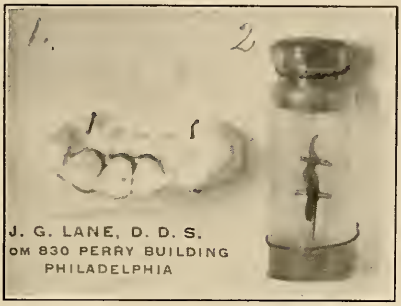


Fig. 3. Iridio-platinum blank for screw. Surplus material for head obtained by partly fusing the end of the wire.

Fig. 4. Heading tool. Made by drilling a hole in a piece of steel and counterboring the hole to any sufficient depth with a round bur. This must be tempered.

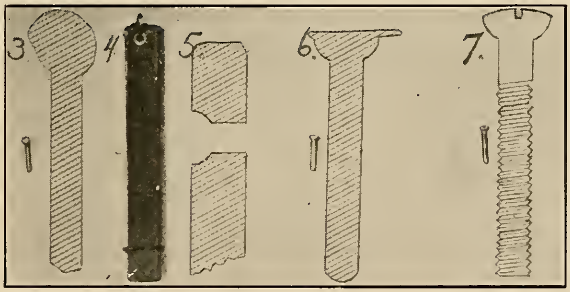


Fig. 5. Sketch showing section of Heading Tool. (Note shape and depth of counter-bore.)

Fig. 6. Screw blank after same has been placed in the Heading Tool and the surplus for head hammered down in counter-bore

Fig. 7. Finished screw. Shank threaded, surplus material on head removed with a file and slot cut with ribbon saw.

CAMPBELL'S COW-BELL METHOD OF CASTING PLATES

BY DAYTON DUNBAR CAMPBELL, D.D.S., KANSAS CITY, MO.

In describing this simple and unique method of casting aluminum plates, we will not go into the question of the superiority of the cast metal denture over one made of vulcanite, but give in a homely way the procedure in detail:

INVESTMENT MATERIAL

After taking your impression, coat it with your favorite separating fluid and *when dry rub well* with *soapstone* and pour with an investment compound after the formula originated by Dr. C. C. Allen, which consists of *equal parts of Portland cement and dental plaster.* This compound is in keeping with the simplicity of the casting machine, and in fact, is cheaper than plaster, sets very fast and is free from shrinkage and expansion, making an ideal compound in bridge work.

It is hardly necessary to say that the plaster and cement must be mixed dry beforehand, and so thoroughly that when patted down with a spatula no particles of plaster are distinctly recognized. To obtain the best results, this material must be worked thicker than plaster.

SEPARATION

On separating the impression from the model, if the former when poured is jarred down well, the model will present a finished surface. The part of the *model* the plate is to cover is now *rubbed* well with *soapstone.* This gives the model a metallic luster and a surface very desirable against which to cast metal.

WAX

The model is now covered with a new, clean piece of common yellow *base-plate wax* and care taken that is of *even thickness* throughout, and that it has not buckled on the ridge in the median line. The wax is now *trimmed* as you wish the *plate to be,* and care taken to cut it low where the depressor muscles have action, usually in the region of the first bicuspid. The *outer edge* of the *wax* is now *stuck* to the *model* all the way around with a dry, sizzling-hot spatula, held at a right angle with the wax. A *strip of wax* 3-16 of an *inch wide* is now cut lengthwise from a sheet of wax and *laid* down *flat* on the *wax* model, even with the edge, except near the heel of the plate, where it is brought over to the lingual surface. The wax strip is brought as near the top or bottom of the ridge on the palatal or lingual surface as the case will permit, the idea being to do away with as much rubber as is possible. The outer sixteenth of this strip is now made a part of the wax model by thrusting a dry, hot spatula through the strips all the way around *until the model is felt* beneath. The surface next the outer border of the strip is now filled in with wax and smoothed up with a chip blower and alcohol lamp, care being exercised to leave the inner edge of the strip square. At this point lower the temperature of the wax, which has become soft by working, by dipping model and all in water that is not cold; then, with a dull instrument, *raise* the *inner border* of the *wax strip all the way round.* It should be lifted away most near the canine eminence and the lingual border of the heel. If this is done right, it affords all the attachment necessary. Sometimes it would be impracticable to use the strips on the labial border; it can be done away with altogether, and for the attachment of the rubber, loops of German *silver or aluminum can be set in place* on the *wax* and *cast successfully.* Of course, there is no union of the metals, but they are held in place mechanically tight enough to serve their purpose.

If you desire to cast directly on the teeth, the front is left open for the pink rubber, and a space of one-half to one-millimeter left between all the teeth. This is imperative, because the contraction of the alloy or metal used in casting the teeth would all be checked or broken off.

The model is now trimmed even with the heel of the plate and a little roll of wax, about the size of a slate pencil and about three inches long, is stuck on the model with a hot spatula, even with and joined to the wax plate. Don't lay this piece of wax over on the wax, as it will not facilitate casting, but will be difficult to remove in the cast. The last thing to do before you invest is to cut the model all over to get rid of the "slazy" surface it has taken on from handling, rubbing with soapstone, etc., so it will unite, so to speak, with the investment, and put it in a bowl of cold water. *The flask is a No. 5 Hoosier cow-bell,* and will cost you seventy cents.

The strap at the top of the bell is placed in a heavy vise and removed. The rivet that holds the clapper is filed off some and driven out with a punch. A one-eighth inch hole is bored a half-inch from the mouth of the bell at its extreme width on either side, to afford attachment for three feet of bailing wire, and you now have a plate-casting machine.

INVESTING

To invest: Begin mixing your home-made investment compound, and while it is thin, remove the model from the water and with a camel's hair brush fill in the grooves made by lifting the wax strip; then, working quickly, mix the investment thick and pour it in the cow-bell (it should be not quite *two-thirds* full), now put in the model; then, by holding the cow-bell between the thumb and three fingers of either hand, the index fingers are left free to push the model down; it should be jarred and pushed down until the model is about an inch below the surface, or say until the fingers are in the investment to the first joint. Now remove the fingers, and by pressing on the wax pencil the model is kept in place while the jarring is continued until the surface of the investment is even.

The surface now presents a semi-liquid appearance which is immediately sprinkled with the dry investment to hasten the setting. In a very few minutes the top of the investment is scraped with a large vulcanite scraper (no attention is paid to the wax pencil, it being cut or twisted off and scraped down with the investment); until it is firm and solid. Then the investment, from an inch to an inch and one-half on all sides of the wax, is lowered about one-half inch and the whole top washed out to get rid of any small particles that might fall into the investment and cause a hole in the plate.

The bell is now placed on a *slow fire* and the *wax* burned out.

This idea of the disappearing model, of course, belongs to Dr. Taggart, and it is to him all credit should be given should this article prove beneficial to you.

The *burning of the wax* usually takes *an hour or more.* When the bell can be removed from the fire and there is absolutely no smoke issuing from it, you are ready to cast. The flask does not have to be very hot, and for this reason a very good cast can be made over a common plaster-paris model. If you are going to cast directly on the teeth, the method of investing and removing the wax is also a little different. The teeth are painted with whiting to prevent any excess of the metal adherent to the porcelain, a phenomenon that occurs that to me is very striking. An attempt to remove a film of the aluminum that may have run over one of the teeth without whiting means to remove just so much of the porcelain.

Place the flask on its side in a clean vessel and fill with *cold water* until it is covered *two* or *three* inches, *set on a slow fire* and bring to a boil until the *wax is all out.* Place on fire as before and heat slowly, but in this case, before you cast, the case must be heated pretty hot to bring the temperature of porcelain up to something near the temperature of the molten metal.

To cast, the cow-bell is laid on one side with the mouth elevated an inch or so. An ingot of pure aluminum is then laid in the mouth of the bell and melted with a common gasoline blow-pipe. As the metal melts the bell is raised and it runs over the hole left by the wax. This is done for two reasons—first, to keep out any small particles that might fall into the mold, and to give you better access with the blow-pipe until the metal is thoroughly melted "and a little bit more," then, without hurrying, but rather on the pokey order, lay aside the blow-pipe, take hold of the bale, already cold, and get where you will have plenty of room; swing the bell back and forth like a pendulum once or twice, and then over your head, like you would a small bucket of water. The plate is cast, of course, the first round, but the swinging should be kept up a half minute, so that crystallization may take place under pressure. All casts made in this manner are better on account of their closer molecular construction.

The flask is now allowed to cool and the investment and plate shaken out. the excess cut off with a hack-saw and the plate finished.

The impression can be waxed up or the model scraped down at this point, but it is purely guess work and unscientific. *As a last resort,* when the plate is cast and *still* needs to be *raised* at this point, a plaster model of the plate is poured, and when very hard, removed and scraped down as far as you want the plate. The plate is then placed back on the model and with a ball hammer beaten down to place.

SOME PHASES OF THE CASTING PROCESS

BY C. S. VAN HORN, D.D.S., BLOOMSBURG, PA.

To test a pattern wax hold a piece in the mouth until it assumes body temperature, when, if it becomes plastic, susceptible to change on moderate pressure either by the teeth or fingers, it is not suitable for the purpose for which it was designed. There is a long train of maladies attending the use of a plastic wax that may be largely or entirely eliminated by the use of a non-plastic wax.

Assuming the cavity to be approximo-occlusal, involving all or part of one or more cusps, either of bicuspids or molars, the wax, which has previously been softened in water at 180 degrees F., is quickly thrust into the cavity and molded quickly to place, and the patient directed to bring the teeth into normal occlusion, when with the fingers and proper instruments the buccal surplus is pressed into contact with the buccal wall of the cavity, the instrument being pressed into the interproximal space, thus forcing the wax into contact with the cervical margin of the cavity. As a generous surplus of wax has been used we have a rather uninviting appearing mass, which is soon reduced by rough carving to something like normality. In carving it is of the utmost importance that the pattern remain stationary in the cavity, *i. e.,* without moving and rubbing against the cavity walls; the best way to prevent this is to carve the occlusal surface before disturbing the contact of the pattern with the adjacent tooth. The support given to the pattern by the adjacent tooth, together with properly directed force in carving, enables us to make the most extensive restoration with seldom an appreciable movement of the pattern. After the occlusal surface has been carved, our attention is directed to the lingual margins, then to the buccal margins, and lastly to the cervical margins, all these margins being finished flush with the square tooth-margins for reasons previously described.

We now have a pattern—not an impression—carved to form, except that it has a contact surface—not "point"—with the adjacent tooth, and is unpolished. The polishing should be done in the same order as the carving: First, the occlusal surface is gone over, touched where necessary with the carving instrument to bring out any artistic lines, and highly polished; then the lingual and buccal margins. Then with a pellet of cotton wet with cold water and held against the occlusal surface to prevent any movement of the pattern, a hot, very thin flat instrument is passed between the adjacent tooth and the pattern, and the abnormally large contact surface converted into a normal contact point, and polished with a wisp of cotton, the teeth having been previously separated, as they always should be, to admit of a subsequent normal contact being formed.

If all the steps have been followed with precision and a high regard for artistic attainment, we have a beautiful restoration of the lost part in wax.

To extricate the pattern an explorer is usually employed, though any of the well-known methods may be used, being especially careful to prevent the slightest marginal distortion. Here again it is of advantage to have square margins where sheltered, for it is manifestly easier to remove without distortion a pattern with square, well-defined margins than it is to remove one with feather-edges. The pattern is then attached to the sprue and examined under a magnifying glass to ascertain its perfectness, and if it is found to be flawless in its marginal impressions any carving which may be deemed essential may be done on the cavity side—and I might say right here that it is seldom that the cavity side of the pattern should not be carved, believing that by so doing we increase the efficacy of the finished product. This carving on the cavity side may be easily and expeditiously done with a light, sharp lancet or a bur in the engine, or a combination of both. The finishing touches being completed, the pattern is ready for investing.

INVESTING

It is just as essential that the investing be properly done as any other part of the procedure. I have noted that some use scales, others measures to apportion the investment and water. I am not prepared to comment on this procedure, except to say that at present I use neither. The investment should be mixed just as thick as it can be and yet admit of the pattern being properly invested, and as it requires more time to coat a complex than it does a simple pattern, it is obvious that the investment should be mixed accordingly. Then, too, some are more dextrous than others, being capable of working with a much stiffer mix. Personal equation being such a potent factor in all our work makes it next to impossible to formulate laws for operative procedures in the field of dentistry.

Ten to fifteen minutes after investing the pattern the investment is, or should be, sufficiently hard to admit of the sprue being removed, which should be done by heating the sprue to a full red heat for several minutes and twisting it out with pliers, thus preventing any distortion of the mold. Remember that we are dealing with the investment while in a semi-set condition, and great care is essential to success.

The flask is immediately placed over a very low flame, a flame of just sufficient heat to drive out the moisture without creating steam, and as soon as the investment is dry the flame is increased and the wax burned out. Formerly, the investment was allowed to dry over night, but I believe this to be at variance with scientific findings relative to the setting of plaster of Paris, one of the ingredients in the investment. Be this as it may, I obtain better results by placing the "green" investment over a low flame ten to fifteen minutes after flasking—the castings are just as smooth, just as sharp, and without "feathers."

CASTING

It is obviously impossible to go into extended detail of casting without considering the numerous devices that have been placed upon the market for the purpose, and this in itself would require a paper of considerable length. My advice, therefore, is after mastering cavity preparation and formation, to master the complete technic, and then it is time to master the device with which you expect to do the casting. I fear that a great many have fallen and that more will fall by the wayside by beginning at the reverse end. That which goes to make up the entire casting problem is by no means easy of solution, nor suited to perfunctory methods or desultory application.

At present our work in this field is largely empirical; we have not practiced casting sufficiently long to have established it on a scientific basis, consequently we are too many times between the devil and the azure brine to know the how and the why. Some day the clouds will clear, and we shall broaden our horizon and place casting on a scientific basis. Then we shall have what we have not now, a perfect casting machine, a machine which will be automatic in its action, indicating the exact pressure on the gold in the mold and at the same time the temperature of the metal, just as our pyrometer furnaces indicate the temperature of the porcelain. This together with a perfect pattern wax and a perfect investment material will have a powerful influence in eliminating stumbling blocks in the paths of those not especially adapted or reasonably versatile.

The two most important considerations with the present machines are to determine the requisite pressure and the proper state of fluidity of the gold. Too much pressure will expand and crack the investment, causing an imperfect casting, and if the gold is not sufficiently fluid a sharp casting is not to be anticipated.

No machine of which I have any knowledge will give an exact, sustained, determinable pressure on the gold in the mold, and with the machines of the "plunger" type it is risky, if you have regard for veracity, to hazard a guess on the pressure. Therefore, no difference what device you use, experiment until you have mastered it, and by that time you will have discovered that the more fluid the gold is at the time when force is applied, the sharper the casting will be.

One way of determining the proper state of fluidity of the gold is this: First, the gold assumes a globule, then the "bull's-eye" appears, and finally we get what may be termed the sun-glow. When this stage is reached, if you are watching the gold very closely, you will notice a very slight spreading and flattening of the globule; this is the time to put on the pressure, and if it is done properly, and if 24k. gold in very generous quantity—a quantity admitting at least 5 dwt. surplus—is the metal, you may be reasonably certain of success, though on rare occasions failure will stare you in the face. But, since it is in degree by our failures that we advance, they are not always to be despised but rather viewed as stimulants to subsequent success through fathoming the cause. "If at first you don't succeed," ascertain the cause, for the effect will follow in natural sequence.—*Cosmos.*

THE WORKING MODEL FOR INLAY PRACTICE

BY H. W. ARTHUR, D.D.S., SC.D., PITTSBURGH, PA.

It is not the purpose of this paper to advocate the use of the working model to the exclusion of the direct method of practice in making inlays.

The working model method, aside from the fact that it is not so expeditious, has otherwise all the advantages, as well as supplying the means of overcoming difficulties attending the direct method of practice. In any and all cases, an accurate adaptation to the cavity with contact and occlusion, in bicuspids and molars as well as the more simple cases, can be assured by the working model method. The working model, while specially to be preferred, for the production of porcelain inlays, meets all the requirements for gold inlays. With the working model as it should be, that is, an accurate impression of the cavity, the approximating tooth and the correct occlusion, the operator, in this class of cavities, has control of conditions and the manipulative procedure in a way that he cannot have by the direct method.

Having the porcelain inlay especially in mind, the following advantages may be claimed for the working model:

The cavity can be approached conveniently from all directions, so that the platinum matrix can be more readily adapted.

The porcelain material can be applied with the platinum matrix on the model, thus avoiding the liability to change of form to which the matrix is subject when held in pliers.

Proximal contact and accuracy of occlusion can be gauged on bicuspids and molars, and more readily attained with the anterior teeth.

Several inlays (there need be no limit to the number) of diffierent shades may be made with but little more expenditure of time than for one, thereby giving a choice of the one best suited to the case.

It supplies the means, in case of an accident, of repeating the operation without annoyance to the patient.

Nicety of detail can be worked out at leisure.

The model, properly registered, with shade record, may prove convenient for future use. Aside, we might add, that the temptation to insert a "good enough" inlay cannot be so readily excused.

The above will apply equally to the gold inlay, where the procedure is in common.

To insure the best results, the working model must be an exact reproduction of cavity and surroundings, as found in the mouth. This necessitates that, not only should the impression be accurate, but that there should be no change of bulk or form. Experience has demonstrated that modeling composition and copper amalgam supply the materials that meet these requirements. Where there is direct access to a cavity, a good impression can be taken by the simple method of shaping the modeling composition to a point and then softening the point. This, with the harder composition to give resistance, can be forced to all parts of the cavity and cavo-surface angle.

In most cases, however, a suitable cavity tray is necessary to give resistance to force the impression material to the distant parts of the cavity and cavo-surface angle, as at the cervical margins of proximal cavities and under the gingiva-labial surfaces.

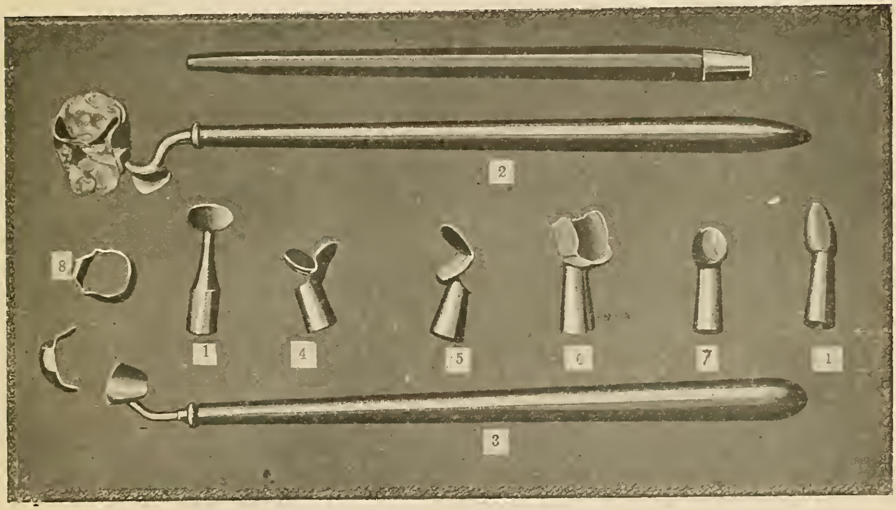
To meet these requirements your essayist has contrived a number of cavity trays, described as follows:

No. 1. Designed for taking impressions under the labio-gingival margins of the anterior teeth.

Nos. 2 and 3. Designed for taking impressions (rights and lefts) of the proximal cavities mesial and distal, of the anterior teeth.

Nos. 4 and 5. Designed for taking impressions of mesio-occlusal and disto-occlusal cavities of bicuspids and molars.

No. 6. Designed for taking impressions where the lingual or buccal portion of tooth is wanting.



No. 7. Designed for taking impressions of labial, buccal or occlusal cavities.

No. 8. Designed for taking impressions of disto-occlusal cavities of third molars, including the occlusion.

A more recent device has, in a measure, taken the place of Nos. 4 and 5. It is designed not only to take an impression of the cavity, but includes proximal contact and occlusion. So that, mounted on the articulator, we have all the conditions of the mouth.

The device is simple, designed to confine the impression material; can be made in a few minutes. The same appliance has been used by your essayist as a matrix in the operation of filling for years. It consists of a thin piece of sheet metal, shaped to pass above the cervical margin and around the embrasures of the tooth, with a lip turned down to rest on the ridge of the proximating tooth. The appliance, when in place on the proximating surfaces of bicuspids or molars, as the case may be, should be wedged lightly at the cervical portion with cotton, where there should be a slight yielding, so that the impression material may pass over the margin of this portion of the cavity.

The lip resting on the ridge of the proximate tooth prevents the forcing of the appliance onto the gum when taking the bite. The parts of the appliance passing around the embrasures should be free and yet not enough so to allow impression material to pass around the embrasures to the extent that it will interfere with the withdrawal of the impression.

Sufficient impression compound should be used to fill the cavity and cover the occlusal surfaces of the adjacent teeth. The patient should be instructed to bite and give lateral motion. With the impression in hand, copper amalgam is prepared for inserting in the usual way. It should be inserted with care, pressed well onto the thin margins, over the impression of the cavity and embrasures, and well onto the occluding surface of the tooth. It is better to wait until the amalgam has hardened before completing the mounting on the articulator.

On the articulator the slight obstruction to exact occlusion, caused by the lip of the matrix, is corrected in the absence of the obstructing lip.

The thickness of the matrix does not interfere with securing the correct proximal contact. The working model should supply all the conditions of the mouth; it has, in addition, all the aforesaid advantages for manipulations.

The appliances we have described are so readily made, and the taking of an impression so simple, that it is well to have it at hand, even though it may only be for contingencies.

Where the occlusion and contour can be allowed, as in the anterior teeth or on exposed surfaces, the copper amalgam counter of the impression of a cavity can be mounted in plaster in a suitable receptacle, thus supplying a convenient means for forming the platinum matrix by the use of the water bag, under screw pressure, and for correcting the shape of the matrix, if need be, after the first fusing of the body in the matrix.

The convenience of the working model for making gold inlays is too obvious to enlarge upon it.

Having as an object the insuring of the best results, as a means to that end, the working model has a place not only in inlay, but in other lines of practice.

COMBINATION FILLINGS OF CAST GOLD AND PORCELAIN OR SILICATE CEMENTS.

BY DR. C. H. NEILL, FAIRMONT, W. VA.

This is a method of using cast gold inlays in conjunction with low-fusing porcelain and silicate cements.

In the large approximal incisor cavities in the anterior teeth, to replace the ordinary contoured filling or contoured inlay, I prepare the wax model in the usual manner and remove the labial aspect of it; prepare in the labial aspect a box-shaped cavity, cast inlay, cement into position, and start a new operation on the labial cavity prepared in the inlay. That gives us the same strength of a gold inlay without the labial aspect of gold. If artificial enamel is used the incisal edges can be well protected. If low-fusing porcelain is used as a veneer there need be no gold showing at all.

CONDUCTIVITY OF CAST INLAYS

BY S. H. GUILFORD, D.D.S., PHILADELPHIA.

The danger of pulp irritation and often the devitalization from placing a metal filling in contact with a thin layer of dentin overlying the pulp has long been recognized and, in a measure, guarded against by interposing some less conductive substance between the two.

For this purpose different materials have been used, such as a coating of varnish, a layer of paper or asbestos with some adhesive and non-irritating medium to hold it in place, and either alone or in connection with any of the foregoing, a layer of one of the cements.

These have answered their purpose remarkably well in connection with foil fillings but only the last one has been found really available when cast inlays are used.

If the employment of an intermediary is deemed essential under a foil filling in large or deep cavities, an even thicker layer of non-conductive material is necessary under an inlay to insure subsequent comfort and guard against pulp devitalization.

However dense a foil filling may be it is never so dense as an inlay. The former contains a portion of air between its particles and air is one of the best non-conductors. In the latter the molecules are more closely in contact and thermal changes are in consequence more rapidly transmitted.

In this fact lies one of the chief dangers in the employment of the cast inlay. Another fact worthy of consideration is that a gold filling may be removed piecemeal if for any cause the tooth should be sensitive to thermal changes after being filled. A cast inlay could not thus be removed and would have to be pried out with wall fracture as an almost certain result.

We therefore feel that the necessity for providing against thermal shock under cast inlays should be strongly emphasized.

It has been a common practice, in deep cavities, to partially fill them with cement and then give to this material and the adjacent walls the shape necessary for the placing and removal of the wax inlay form. This is a good practice and in many cases has to be resorted to, but it takes time, and delays the completion of the operation.

A better plan, in cases where caries has not made too extensive inroads, is to remove only the softer portions of decay and prepare the cavity so that the wax form will draw, at the same time shaping all margins in the most careful manner just as we wish them to remain.

After the inlay is constructed and ready to insert the inner portion of the cavity is further excavated and prepared in the usual manner. The removal of this last portion of decalcified material forms a space for the cement to occupy when the inlay is set. But this is usually not enough. The wax form after its removal from the cavity with the sprue-wire firmly imbedded in it should be reduced in size on its cavity side so as to provide greater space for the non-conducting cement.

This is an exceedingly delicate operation owing to the danger of distorting the form and rendering it useless. To trim it with a cold spatula or bistoury would necessitate the application of too much force. A heated spatula would be liable to melt too much of the wax and cause it to flow and ruin the form. Heat, however, seems to be the most available medium for the purpose if some means be provided for carrying away the wax as fast as it is melted. For this purpose a couple of devices have been placed on the market consisting of a handle with a bulb or receptacle near its outer end and a metal or glass capillary tube leading from it. The handle is hollow and connected with an exhaust pump of some form.

When the bulb is heated the free end of the small tube is applied to the portion of the wax form to be removed and as it melts is drawn by suction through the tube into the bulb where it is absorbed by the cotton.

A device of this kind serves its purpose admirably but it lacks simplicity. An equally efficient method, but far simpler, has been suggested by someone and adopted by the writer. It consists of an old excavator from which the point has been broken and the shank slightly roughened with a file. If cotton is wrapped in a spiral about the point for half or three-quarters of an inch and the shank heated some distance farther back, the point, when applied to the wax form, will melt it and the cotton instantly absorb it.

In this way, with deft handling and the occasional renewing of the cotton, any quantity of the wax form may be removed, and any shape given it. In fact, the wax which is usually convex on its under side, may, by this method, be made concave or partially hollow, which will not only materially lessen the amount of gold used, but also aid considerably in its retention.

The main object, however, in removing a portion of the wax form is to provide space for a greater quantity of the non-conducting cement.

The writer has also found it of advantage to groove the wax form for retention purposes instead of doing it later on the cast inlay. To do it after the gold has been cast is a delicate operation sometimes resulting in twirling the small piece out of the fingers onto the floor and occasionally wounding the fingers when a small circular saw is used.

Grooves are easily cut in the wax form, if the sprue wire is firmly attached to it, by drawing a fine excavator along the surfaces to be undercut. A fine bead will be raised on each side of the groove but this is easily removed from the gold surface after casting.

With the rapidly extending use of the gold inlay, improved methods of removing surplus wax from the form and of grooving its sides will probably soon be evolved from the brains of the many who are concentrating their thoughts upon the further development of this most valuable method of tooth preservation and restoration.—*The Garretsonian.*

HOLDING INLAYS WHILE POLISHING.

BY DR. G. B. SPEER, LOS ANGELES, CAL.

In the February number of the SUMMARY, Dr. R. C. Brophy, of Chicago, gave a description of Dr. Moore's vise for holding inlays while polishing. My way is as follows:

Take a pair of Dr. W. Van Hook's (or other make) mouse tooth hemostatic forceps, which can be gotten at any surgical supply house for $1.25. Snap them on the inlay and you can hold it in any shape desired. Also, let your assistant turn a stream of cold air on the inlay while grinding and it remains cool. The assistant and cold air have been a great help to me at the chair by keeping the bur cool while cleaning out cavities.

And while you are buying your hemostatic, also buy a five-pound can of surgeon's green soap and use same for moistening felt and brush wheels in polishing plates. The remainder may be used for washing the hands. Once you have used this soap you will never go back to any other. It is not only cheaper, but cleanses and softens the hands much better.

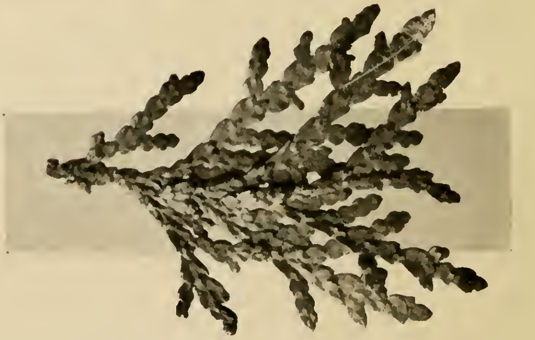
How I make a sprue wire for holding and removing inlays: Take a German silver wire and flatten the end with a hammer; now trim off the edges until the flat part is only as wide as the thickness of the wire; now hold the wire in your pin vise, catching close to the flat part, and with a pair of pliers twist the flat part to form a screw, point the end with a file and you have a sprue wire that will hold.

Do not warm the wire, but insert by a pushing twist, thus screwing the sprue into the impression. Blow a stream of cold air on the impression and your wire will hold.

METHOD OF REPRODUCING FLOWERS, INSECTS AND THE LIKE BY CASTING

BY T. C. HUTCHINSON, D.D.S., DECORAH, IOWA

As time goes on the science of art and invention are making rapid strides towards producing wonders in the mechanical line, all for the benefit of man, to aid him in accomplishing work more rapidly, in doing it better, and at the same time making work easier on the man. This is certainly an age of invention and the dentist who thinks that he knows all about the casting of inlays, crowns, etc., has yet something along these lines to learn.



With the invention of casting, the dentist does his work more rapidly and in the hands of the average man, more perfectly, than by the use of former methods of accomplishing the same results. The dentist has more time in which to rest and occupy his time with things of interest, and the writer knows of nothing that would give him all of this, better than the making of metal flowers, etc. To practice this work you will not only find pleasure in the work but you are bound to learn something relative to your work in casting plates, etc. The illustrations here presented of the cast figures will give you an idea of its possibilites.

In a few words I will tell you how to go at it: Take any flower, no matter how delicate it may be, and immerse it in a mild solution of

sandarac varnish, shaking the surplus off by taking hold of the stem; then mix the investment material, and with a camel's hair brush paint the top of the petals as you would your wax inlay. Next, if it be a flower of several petals, pour some of the investment material in the palm of your hand and lay the flower in this and pour more investment over it; jar your hand and the investment will fill up all of the interspaces. (Note that the coating of sandarac attracts the moisture of the material.) Having poured some investment in the bottom of your flask, take the partially invested flower by the stem and lay in the flask and then pour the flask full. Use the stem of the flower for the sprue. Make the crucible form for your metal the same as for inlay work.

In burning out the flower, which is placed as close to the bottom of the flask as possible, put your blast heat on the investment instead of the flask. You will have to make a cast flower to learn how to ascertain the time required to burn it out. With the heat directed near the flower one should not consume much more time than it would take to burn out the same amount of wax.

CAST BACKINGS AND CROWNS FOR STEELE'S FACINGS

BY JAMES B. DOYLE, D.D.S., GRAND RAPIDS, MICH.

First take the Steele facing, then a piece of platinum or pure gold, about 36-gauge. Pinch it together and insert it in the groove, then take a small instrument and burnish it to place so that it fits the groove perfectly, then take a piece of 22k. plate gold or platinum and cut it so it will readily pass into the root canal and the groove of the facing Remove and solder these two pieces together; after greasing your facing with vaseline you are ready for your inlay wax. Mold it as well as possible to the back of the facing and your root-canal pin. Then after the wax is properly warm you insert it in the root canal and press up firmly. Remove and carve until you have the shape desired. Then remove your facing and you are ready for casting. Now you have a perfect fit of your facing to your backing and a perfect fit to your canal.

I cast all my backings for Steele's facings. You proceed in the same manner except that you do not use a pin. There is a great advantage in making bridges with Steele's facings and casting your backings. The reason so many facings break is because you cannot get uniform thickness with solder. You will get a little more solder in one place than another and it is liable to spring. That spring will be just enough to crack your facing. And another thing, you cannot always get your backings to fit so that the stress of mastication will come upon it. By casting your backings you overcome these difficulties.

AN ANTERIOR CAST BRIDGE

BY E. CUNNINGHAM, PERRY SOUND, CAN.

Prepare roots for abutments and adjust platinum caps. Pass pins through the caps and attach with solder. Take bite and impression: make model and grind facings. Remove pins and caps from the model and enlarge pin holes so the case will draw easily. Replace abutments on model and wax all facings in position, attaching sprue so that gold will not flow direct against the porcelain. The case is now ready to be invested and cast.—*Dental Review.*

HOW TO OBTAIN A SMOOTH, DENSE SURFACE ON CASTS.

BY F. L. OLDS, D.D.S., CLEVELAND, OHIO.

To insure smooth, dense surfaces on plaster casts, also on casts made of investment materials, we recommend that impressions of all-plaster be used; or, if modelling compound or wax be used, that a thin layer or coating of plaster be applied to the surface of the impression.

To prepare the impression for pouring a model of model-plaster (New York plaster), for vulcanite work, first give the impression a thin coat of shellac varnish. When this has become dry, which it will in about thirty minutes, give the impression a thin coat of sandarac varnish. This also should be given time to harden, about twenty minutes, after which we place the impression in water and allow it to become saturated before pouring the model. As an experiment, take any piece of plaster that has been lying around the laboratory for a few hours, and put it in water; bubbles will rise on the surface very freely, even through a varnished surface. Now, if freshly-mixed plaster or investment material were placed in a dry impression, the same thing would occur; bubbles would come from the surface of the dry plaster and a model full of holes, forced in by these bubbles of gas, would be the result. The reason for using the varnishes, as stated, is that the shellac acts as a filler on the fresh plaster surface, just enough being used to fill the pores and stain the plaster to a slight depth, leaving the surface, so far as the fine lines of the impression are concerned, just as it was before varnishing.

If the impression were to be poured at this stage, with just the shellac as a separating medium, there would be difficulty in separating, as the plaster, in setting, creates enough heat to soften the shellac and thoroughly glue the two parts together.

Some are in the habit of using oil or soap to prevent this sticking together of the impression and model, but this is not good practice, as the oil or soap will unite with the fresh plaster, and a very poor surface on the model is sure to be the result. So we use sandarac varnish, thin sandarac varnish, as a second coat on the impression. All that is needed is just enough to give a smooth, glossy surface. We prefer a colored varnish, as it is easier to ascertain just how much is being used.

When the varnish has hardened, place the impression in water and leave it there until saturated, so that no bubbles of gas will rise up and fill the surface of model with the holes that we all have seen, and so that the dry plaster will not take up some of the necessary water from the fresh plaster, and give us a porous surface of poor quality.

Sandarac varnish is practically inert so far as the pouring of impressions is concerned and can be separated by carving away the impression over the ridge until the stain made by the shellac appears; then place the point of a knife under the edge and gently break away from undercuts and around teeth.

After separating the impression, the first thing to do is to give the surface of the model a good coat of castgloss, or silex, before anything else gets onto the surface. Hot wax or grease of any kind, if run over the surface before applying silex preparation, will prevent the plaster from taking up the silex, and a rough, porous surface on the palate of the plate will result.

After applying castgloss, wipe the model dry with a piece of cotton, rubbing hard enough to polish the surface somewhat. Hot wax or any other material may now be run over the surface of the model and the plate will still come out with a smooth, clean surface.

For models of investing material for casting, we prepare the impression the same as above, with the exception that whatever relief is desired for the case should be carved in the impression; and if it is necessary to fit the plate a little closer at the periphery, just add a little wax to the impression, as the model cannot be carved when made of investment material without making a rough surface. The surface of a model for casting should be left just as it comes from the impression, without any alterations whatever.

The surface of any model will be just as smooth as the surface on which it is poured. If plaster is poured onto glass, a glassy surface is the result. If poured on a rough surface, the surface will be rough. Therefore, to have smooth models we must have smooth impressions, and the impression must be treated so that it will be practically inert so far as the pouring of freshly-mixed plaster or investment is concerned.

AN INLAY FOR COMPOUND CAVITY INVOLVING INCISAL WITHOUT STEP

BY H. C. DEAN, D.D.S., COLUMBUS, OHIO

It is often desired to place a gold inlay involving the approximal side and incisal edge, without sacrificing the sound structure of the tooth to make a step. This may be done by placing an iridio-platinum post near the incisal after the inlay has been completed. Inlay should have a wide, deep groove carved in the approximal surface extending from near the incisal to the gingival. This should be done in the wax model. This groove is to pass over the iridio-platinum post, when the inlay may be set from the incisal without interference from an approximating tooth. There may be an extension of this iridio-platinum post for additional retention in the groove of the inlay. Since the inlay model is completed before the incisal retention post is provided, there is absolutely no interference with the removal of the model. The retention post fits loosely in the tooth and in the inlay until cemented. Post and inlay are both set with same mix of cement.

CASTING, WITH SPECIAL REFERENCE TO CASTING ON PORCELAIN

BY W. C. GILLESPIE, D.D.S., NASHVILLE, TENN.

The process of casting metal under pressure has opened the greatest field of possibility for saving and restoring teeth that the dental profession has come into in many years. The casting machine stands next to the dental engine in line of improvement in dental equipment and in variety of uses to which it may be put.

There are countless numbers of devices for casting metal under pressure, but all are variations of four basic types—those that utilize centrifugal force, suction, compressed air, or steam pressure.

The application of pressure casting — a very old process — to dental art will raise the general average of tooth-saving ability, practical merit and artistic product of the profession, because it will enable the less skilful practitioners to form in plastic substance and reproduce in metal better dentures than they were able to do direct in the more refractory substance.

Casting is neither an experiment nor a fad; neither can it be conducted on the nickel-in-the-slot basis. A few porcelain facings or teeth and a little scrap gold dumped into the machine before you go to dinner will not be a beautifully finished bridge when you return. Brains are as essential to successful casting as a properly constructed casting machine and necessary materials.

The limitation of the application of casting depends entirely upon the ingenuity and skill of the one who employs the process in constructing dental restorations. By this means anything of which a mold may be obtained may be reproduced in metal with ease.

Castings consisting entirely of metal, such as inlays or all-gold bridges, may be produced; or gold may be cast directly in contact with porcelain surfaces without a previous adaptation of backing. A simple inlay or a six-tooth bridge may be cast with the same ease and same amount of labor in so far as the casting is concerned.

The amount of time required to cast an inlay may be as long or shorter than would be required to condense foil in the same cavity; but the physical labor is not a tenth part so strenuous, and the patient will rise up and call you blessed. More patients may be seen in a day, because when the wax model is obtained the patient may be dismissed and the casting made when there is nothing else to do.

The advantages of cast gold over welded gold are too well understood to need comment. As to where the inlay is preferable to a condensed filling depends entirely upon conditions to be met in each case.

The time required to construct a bridge by the process of casting is very much less, as a rule, than that by soldering, and the time and labor are just as much less as would be necessary to do the things avoided by the process of casting—namely, greater amount of grinding porcelain bodies, backing, making dies, swaging cusps, waxing cusps in position, coaxing solder to go where you wanted it and grinding off the excess solder you knew you did not need but were afraid not to put there.

The time required to wax up, invest, dry out, and heat up is the same for either process; but the actual casting requires much less time than building up the amount of solder would do.

Grant, for the sake of argument, that the *time* required by both processes is the same for a given case, the results obtained, labor and material saved, and avoidance of fatigue and discomfort to the patient place casting far ahead of condensing fillings and soldering crowns and bridges.

The dentist who casts only inlays is certainly blind to the possibilities of a simply wonderful and wonderfully simple process which he is employing only in its most insignificant application, as valuable as the process of casting inlays may be. And the dentist who does not cast at all is either utterly non-progressive or too cautious for his own and his patient's best interests.

The process of casting, intelligently employed, is thoroughly applicable to the construction of shell crowns, all-gold bridges, retaining appliances for regulations or pyorrheal teeth, porcelain-faced crowns, bridges wherein porcelain facings, ordinary rubber-plate teeth, diatoric teeth, saddle-back teeth, removable-pin crowns, or Logan crowns are employed for abutments and dummies and for adapting Logan crowns to roots.

Any type of porcelain tooth may be cast upon without backing, but care should be exercised not to use a tooth with pins soldered in position or a pin of composition metal that might have a fusing point below that of gold.

Backing as employed in the old process was to give a surface upon which solder would flow evenly and not ball up. It had little to do with the prevention of checking of porcelain, however contradictory that may sound to the teachings and accepted theories of the past. A direct contact of porcelain with heat or flame will not cause checking, provided the cold body is not thrust suddenly into a flame or furnace, but is permitted to heat gradually at first. It may then be carried to a degree considerably above the fusing point of pure gold; and if allowed to cool gradually, no checking will occur, though this be done repeatedly.

Borax never yet caused a piece of porcelain to check, except indirectly; yet this statement would be regarded as damning heresy by the old masters. These things I have proven by hundreds of tests and experiments during a practice of nine years and four years' experience with a porcelain furnace. While writing this paper I have had in my electric furnace an ordinary plate molar tooth, a Logan crown, and two diatoric molar teeth, which were rolled in damp powdered borax and placed in the furnace covered with a layer of borax, and the hole in the diatoric teeth filled with it. A nugget of pure gold was placed with them and fused, and the teeth came out without a check, but were most beautifully glazed on surfaces that had been ground with a stone. The borax may unite with the porcelain and cause it to become more brittle if carried very high, but the experiment is cited in proof that it does not directly cause checking.

Checking of porcelain is more often caused by unequal expansion and contraction than anything else. This is due to lack of uniformity of distribution of heat or the sudden heating or cooling of the surface or part of the porcelain body. Different degrees of heat produce different degrees of expansion and the surface or some portion of the body of porcelain heating or cooling faster than the interior or some other portion of the mass; and porcelain being a low conductor of heat, an unequal stress is set up that is relieved only by fracture.

Fracture is also caused by permitting molten solder in soldering or molten gold in casting to flow around an edge, and in the contraction of cooling a grip is set up that will break any porcelain made. Such fracture is due to improper waxing up of the case for either soldering or casting.

It is also claimed that a metal pin in a porcelain body—such as the post of a Logan crown—will expand faster than the porcelain, and thus cause fracture. That claim sounds plausible, but is little more than sound, for a degree of heat that would expand the metal sufficiently to do that would have already fractured the porcelain by suddenly expanding the surface. Also where there is a post baked into a tooth, heat will be conducted into the center of the mass by the metal as well as being absorbed by the surface, and the distribution will be more uniform than if the post were not present. If the heat were applied to the post directly and conducted to the interior of the porcelain while the surface received a much lower heat, then the expansion of the post and the layer of porcelain surrounding it would be faster than that of the surface and fracture would result. But to do that would require considerable trouble to bring about something nobody wants.

The fractures indirectly caused by borax are brought about by a union of borax with the porcelain, causing it to lose its elasticity and become more brittle, as is the case when gold is alloyed with some base metals. This loss of elasticity renders it less capable of resisting the stress of expansion and contraction, and a slighter inequality of temperature will cause a fracture, than if the integrity of the porcelain had not been impaired.

An inlay or all-gold casting of any nature may be successfully cast in a comparatively cool or a cold mold, as is proven by castings of iron and brass foundries. But to cast upon porcelain without fracture the mold must of necessity be brought to such a temperature that the porcelain bodies contained will be subjected to no undue strain of unequal expansion by sudden contact with molten gold of much higher temperature.

The investment ring is readily raised to a red heat; but investment material is a low conductor of heat, and several minutes will elapse before the heat is distributed throughout the mass. So, unless sufficient time is given, the porcelain in the mold will be several hundred degrees cooler than the surface, and the molten gold forced into the mold will fracture the porcelain just as cold glass fractures by sudden contact with hot water. Get the porcelain in the mold thoroughly hot and you may cast all the gold on it necessary for any denture ever put in the mouth, and the tiniest facing will never be checked if properly waxed and invested. No flux is needed for any cast, and borax when fused is very sticky and, uniting with the investment, interferes with the entrance of gold into the sprue-hole.

Logan crown joints may be fitted as accurately as the margins of inlays, and thus they become the most perfect crown restorations known to the profession, and may be perfectly adapted to roots far below the gum line all around or at any point. Molar stumps in the same condition may be easily and beautifully restored the same way by placing a pin in each canal and using plate teeth with pins baked in or diatoric teeth. No fear need be had in casting into diatoric teeth, for the molten gold enters the recess in them at its maximum expansion, and the contraction upon cooling makes the post thus formed slightly smaller.

Removable pin crowns, such as Justi's, the Davis, etc., have no lateral openings, as have the diatoric teeth; consequently the molten gold will not enter and completely fill the recess provided for the pin because there is no avenue of escape for the air caught in the recess. It, therefore, is better to remove the crown from the wax before investing, and the porcelain need not be subjected to heat at all, but may be cemented on the post after the gold that perfects the adaptation to the root has been cast onto the post.

To use such crowns for dummies, clip the post off to the desired length, insert in crowns, wax crowns in position, chill with ice water, slip crowns off posts, cast, and cement crowns in place, and you have a most beautiful and practical case. Crowns and dummies thus constructed are far less apt to break away than those backed and soldered. for they are supported by perfect contact of gold at every point, while a backing touches only here and there, and their retention depends almost entirely upon the strength of the pins baked into the porcelain. And if one should break, grind up and cement another on the post left standing.

Pure gold should be used for inlays and 22-karat gold for everything else. In casting inlays and shell crowns do not waste gold by casting them unnecessarily thick. Hollow inlays are easily made, a much stronger retention is secured, and a greater thickness of cement protects the pulp from thermal irritation. There is on the market a device consisting of a hollow metal bulb, with small extending point, through which a hole extends back to a tube to which is attached a rubber tube with a mouthpiece. This end is taken in the mouth, the metal bulb is heated, and when the hot point is touched to the surface of the wax model to be hollowed out, the melted wax is instantly sucked back into the bulb, leaving edges as clear-cut as if cut with a knife. The same thing may be done with an ordinary hot-air syringe or chip blower having a bulbous nozzle. Solder to the nozzle the shank of a hypodermic needle, having bored out the needle with a small drill. Connect the rubber bulb to the metal tube with six or eight inches of rubber tubing, so the bulb may be worked with one hand and the metal point directed steadily with the other. Mount the wax model of the inlay on the sprue-pin fixed in a base to hold it steady, and then with the point heated suck out any kind of undercut or hollow you desire.

This is but a small part of the merits and possibilities of the process of casting as applied in dentistry; but too much time cannot be taken up with one writing.—*Dental Headlight.*

REMARKS ON CASTING

BY ROBERT N. LECRON, D.D.S., LONDON, ENGLAND

At the present time the cast plate seems to hold the center of the dental stage amongst the recent reproductions in metal, especially in England, where plate-work flourishes to a greater extent than in any other country. Hence, those interested in the experimental stages of casting are called upon to answer many questions as to the reasons for this, that, and the other regarding the results, possibilities, and the future of the cast-plate.

This branch of the work still being in its infancy renders some of the questions asked practically impossible to answer. We can only hope to arrive at definite conclusions after a long series of experiments along practical lines, not alone from a demonstrator's viewpoint but from conclusions based upon practical work in the mouth of the dentist himself. Casting under pressure is ancient, yet it is a new idea as applied to dentistry today, and like all new things, is being worked to death, just as porcelain work was misapplied in many instances; but like all things abused it shall find a place amongst the branches of dentistry according to its merits as tested by time.

The echo from all sides seems to be complaint as to the casting of thin gold plates. It seems strange that so much stress should be laid upon the idea of a *thin* plate. True, in the case of gold the thin denture is that which is desired and necessary, but, nevertheless, it is curious that a thin gold plate, full or otherwise, should be the source of so much trouble and comment, when some of the following details are taken into consideration. From a casting standpoint only, the thicker the plate or the more bulky the object to be cast, the greater the air space or cushion within the mold to get rid of, after the wax or object has been burned out and the greater the amount of metal necessary for the casting of same, and in like proportion the greater the surplus metal required, consequently a greater heat must be used to melt this bulk of metal and a still greater care to see that it is not only molten but in a proper condition to flow into a mold. Then, too, the greater the mass of molten metal over the gate openings,* especially with gold or any of the heavier metals, the greater the liability for that metal to sag or even flow into the gate or gates before the pressure is applied. Hence, the thinner the plate or the object to be cast the less the difficulties and the easier and more certain the result.

One of the most important factors in casting, regardless of the method used, whether it be by gravitation or by pressure, is the getting rid of the air from within the mold quickly and with the least possible resistance to the escape of that air, as the molten metal enters and spreads to the remote parts or crevices of the mold.

While watching various demonstrations on casting, I have heard the question asked and have been asked many times myself: What becomes of the air cushion within the mold? Demonstrators must have an answer ready at all times, otherwise they are liable to find themselves in an awkward position. Some insist that upon heating up the case the air within the mold becomes rarefied—and so it does; but not to the extent of producing a vacuum, as sometimes implied, or anything approaching such a highly rarefied condition. If it were possible to produce a vacuum—the casting apparatus with the method of melting the metal in a crucible directly over the gate openings would be practically useless. If such was a fact, upon melting the metal upon a flat crucible-like surface of one of these highly heated cases, one would naturally expect bits of the molten metal to be drawn into the mold as parts melt and fall away from the yet unsettled portion, instead of melting gradually and remaining in a liquid mass over the gate openings, until a positive pressure be applied.

Perhaps the above is the cause of some failures, where the case is heated until it glows red from within through the gate openings. In speaking of extensive castings where fifteen or more hundredweights of heavy metal are used, capillary contraction is not sufficient to cause the molten mass to globulate to any great extent, far less overcome the suction from beneath, caused by the supposed vacuum within the mold.

The air surrounding the molten mass becomes more and more rarefied, it is true, as the intensity of the heat increases for melting purposes, and no doubt, theoretically overcomes and counteracts the vacuum within the mold, which space has had a greater or less opportunity to cool while melting the ingot. (At least, this is one explanation set forth). If the above be a correct theory, the question then arises: Why, if the mold be ventilated, is the molten metal more liable to sag into the gate openings, or to actually flow into the mold without the application of pressure providing the mold be sufficiently vented than in a case where mechanical vents are lacking?

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*The words gate, lead and runner in this article are used to express what is generally termed sprue.

For instance, before Doctor Taggart conceived the idea of casting as it is now applied to dentistry, some were casting into matrices. Shortly after this method was given out, but not known in detail to the profession generally, many more were experimenting along these lines of gravitation.

This method is known to all and simply consists of a mold with a vent leading from the same to the outside of the investment, and a large gate opening into the same. The metal, instead of being melted over the gate opening, was melted in a crucible to one side with a lead or avenue to the large orifice of the gate opening. As soon as the molten metal was in the proper condition to flow, the case was tipped to one side allowing the metal to flow into the gate or runner and gravitate thence into the heated mold. This method was applied only to small castings, and the success of the same depended not only upon the thorough heating up of the case, a large gate and plenty of metal, but also upon the vent opening to allow for the escape of the air from within the mold. These cases were heated extremely hot, yet the rarefication of the air within the mold thus brought about was not sufficient to secure a perfect result in any instance, unless there was a vent from the mold to the outside. One realizes quite readily how difficult it is to pour water or any liquid into a bottle or closed flask where the air contained within must escape from the same aperture through which the liquid is being poured. If, however, there be another outlet to the atmospheric pressure within the flask the procedure is quite simple.

With castings such as poured by the working jewelers in cuttlefish bone, and those on a larger scale in foundries into molding sand, some of the important details are as follows: *Sufficient vents, a large runner,* depending on the size and the complication of the casting in hand, and *sufficient bulk of metal in a thoroughly molten condition to flow.* At least, these were the prime factors most impressed upon my mind while taking a course in a molding shop. All necessary on account of the mold being cold, and the flow of the metal depending alone upon its own weight and surplus behind called the runner and sufficient access to all parts of the mold to enable the liquid mass to spread quickly to all parts without interference from the air within.

Though a mold be well vented, if it be filled from the top the casting is liable to be full of blow holes. In such cases dense castings may be obtained by giving an extra length at the top of the mold away from the runner—the unsound portion being thus formed in this extra length and cut away afterwards as the deadhead.

In casting a metal under pressure, the conditions are different and allow and necessitate certain changes or deviations from the old method: however, it is always well to bear in mind the law of gravitation and the details governing cheoplastic art.

On account of the metal being melted in a crucible, directly over the opening or lead into the mold, instead of pouring the liquid mass into a runner—this lead or gate must be much smaller in diameter.

If too large, the metal is liable to sag into the same; if too small, the construction offers too great an obstruction to the flow of the metal. With small castings, it is remarkable what a small gate opening the metal may be forced through.

I have been trying to determine by a series of experiments, not yet completed, the *size, length* and number of the gate wires necessary for the various castings in the different metals; for each metal allows of a different treatment. With aluminum or any of the lighter metals, most any size gate seems to answer the purpose; but as there is no tendency for these metals to sag, a very large gate will be found most useful. The heavier metals in large castings require more care in the selection of the gate wires; with such metals as tin and Watt's metal that melt at a low temperature and remain liquefied for some considerable time, smaller gates may be used than with the same case in gold that solidifies quickly.

If attempting a large casting in gold through one lead, there is an influence towards using a large gate wire, thereby rendering a failure more possible. Hence I prefer to use two or more gates leading to various parts of the mold to minimize uncertainties. Casting a metal into a mold in a bulk is quite different from that of casting the same quantity where it must spread for some distance from its entrance into the mold.

In short, with the data to hand, I can but say that I adhere to the following details as nearly as possible until I satisfy myself more fully on this subject. *i. e.,* the heavier and the greater the bulk of the metal to be used with the exception of tin and Watt's metal and similar metals and the thinner the object to be cast, the smaller the gate openings and the greater the number of the same radiating from a common center to various parts of the mold, and last, but by no means least, the flatter the crucible or surface upon which the metal is to be melted.

Certain stress has been laid upon the subject of ventilation, yet a few more words may be added. There are many methods whereby this important procedure may be accomplished. With small work, the porosity of the investment should be quite sufficient. By the word "small" I not only imply inlays, but crowns, bridges—in fact, any design within the radius of two and a half inches. Larger objects may be cast relying upon the same escape for the internal gases, in which cases the procedure of investing is an important detail, *i. e.,* to be certain that the distance through the investment from the top down to the mold is greater than the distance from the mold down through the base, and where the metal must flow for some considerable distance from the entrance of the gate openings into the molds, to be careful that these remote parts be *quite* near to the base, so that as the metal enters and spreads to those distant parts the air confined therein is forced through but a very thin layer of investment to the outside of the cup; and the pressure from above has little chance of driving air through the thick investment over these parts before the metal spreads to the same.

The air within the mold is either taken up by the investment similar to a sponge, absorbing water, and like the sponge, it has a limited capacity, after which the remaining air must be driven through the investment to the outside or remain within with the liability of causing blow holes by reacting upon the molten mass or defects by not allowing the metal to spread. Any air driven out into the investment is driven there under pressure, hence, to further assist the escape of internal air or gases I find it quite convenient to perforate the lower strata of investment through into the mold with a fine, smooth broach before the wax or object is burned out. To leave these mechanical vents open is liable to cause trouble if a heavy metal is to be used; by rubbing some of the surplus investment over the base these holes or vents may be temporarily stopped to hold the air cushion within, which in turn prevents, along with other details, the metal from sagging into the open gate while being melted. As soon as the pressure is applied for casting, these slight stoppings blow out, leaving open vents through which the air may pass with the least possible resistance.

If there is any one detail in the mechanical process more important than another, I should say that it is the melting of the metal. There is a certain condition of a molten metal at which that respective metal will cast to the best advantage, *and it is not the boiling point.* Any ordinary blow-pipe may be used that will, with the proper manipulation, melt the metal quickly with a strong blue flame; in no instance should a large smoky flame be used, for it only tends to oxidize and spoil the working of the metal. Once the metal has been melted, one should not be too anxious to cast, but should employ a small soft flame for a short time upon the already molten mass until certain it is in the proper condition to flow into a mold. Take, for instance, in the ordinary casting of zinc and lead for dies, etc., considerable care is taken that the molten metal is not bubbling from being too hot and, on the other hand, not sluggish from being too cold before pouring. If the metal be in the proper condition one need not be in a great hurry to apply the pressure, for it will remain in a liquid form some considerable time.

In conclusion, simply because the molten metal is to be driven by force into the mold is not sufficient reason for being careless about the melting of the metal, even in such simple castings as inlays, and yet expect an apparatus of any description to duplicate perfect castings under such adverse conditions.

THE TECHNIC OF CASTING — USING STEELE'S INTERCHANGEABLE TEETH AND BACKINGS.

BY DR. C. E. TALBERT, COLUMBUS, OHIO.

I shall not advance any theories or suppositions in the paper which follows, but will give merely a plain statement of facts which have been proven by several years of experiment and daily practice.

The technic of casting a crown or bridge, using Steele's interchangeable teeth and backings, is practically the same, up to the point of investing, as that of a crown or bridge that is to be completed by soldering, the only difference being that the backings and other parts to be cast upon must be *fluxed* in the manner as hereinafter described, and that the waxing must be more carefully done and the piece carved just as it is desired to have it when finished.

Let us take, for example, an incisor Richmond. You are supposed to have the coping and pin in place, either in the mouth or upon a model. It is imperative that the pin be either of platinum or iridio-platinum, as a base metal, such as platinoid, will often become disintegrated and weakened. Select the proper tooth and grind to place, preserving the bevel of the ridge-lap, or increasing it a little if necessary, so that when the grinding is completed it will touch the coping at its extreme labiocervical point only, leaving a V-shaped space between the two. Now place the tooth upon the backing and trim the latter to the tooth, closely on the sides, but leaving it a little longer than the tooth at the incisal edge. Next grind the ridge-lap end of the backing to the tooth, giving it the same bevel. Remove the backing and grasping it with a pair of soldering pliers, hold it so that the beveled end will be level, and place a tiny speck of 20k solder on the corner of the backing farthest from you, as in *Fig. 1*. Hold in the flame until the solder sweats down, but remove before it flows. Next take a piece of 34-gauge pure gold or a piece of platinum foil slightly wider than the backing and long enough to balance on the end thereof, with enough material projecting over the ridge-lap to cover the end of the tooth when the latter is in place (*Fig. 2*). Have this piece perfectly flat so that when it is laid upon the end of the backing it will have a three-point contact, viz: the little globule of solder, the opposite

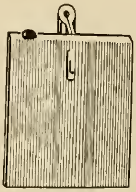

Fig. 1

corner of the backing, and the end of the post. Carry carefully to the flame and hold steadily until a slight movement of the piece indicates that the solder has flowed and the piece settled to place. Now put the tooth on the backing and be sure that it goes easily to place without forcing, not only at this time but after all subsequent operations of soldering or casting. If there is found to be any obstruction, remove it carefully before proceeding further. Now trim around the cervical edge, but leave that portion of the flap that overlaps the backing, which is to be burnished down closely, as is also that part which covers the end of the tooth (*Fig. 3*). Drop the piece, while hot, in pickle and leave for a few minutes. It will then be ready for the flux. The flux to be used—and it is the only one that can be used successfully—is a saturated solution of boracic acid in grain alcohol. This is also a most satisfactory flux for all small soldering operations.

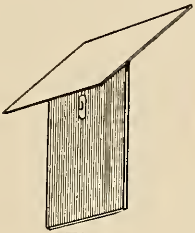

Fig. 2

To prepare a stock solution, fill a bottle about one-fourth full of boracic acid and fill up with alcohol, shake a few minutes and allow to settle, using only the clear liquid. If you have a considerable excess of the powder, the stock can be kept up by occasionally refilling with alcohol. The best way to apply the flux is from an office preparation bottle with a small camel's hair brush, or the piece can be dipped bodily into it.

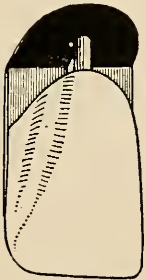

Fig. 3

Take the piece to be fluxed in a pair of soldering pliers and apply the solution. Ignite the alcohol from the flame and allow it to burn off. Then hold the piece in the flame a moment—until you see the deposit fuse, but do not allow it to approach a red heat. Allow it to cool spontaneously and you will find the surface uniformly covered with a thin film of flux that can be handled without displacement and which, in the subsequent operation of casting, will absolutely prevent oxidization of the surface to be cast upon. No care need be taken to keep the flux from the face of the backing, but antiflux should be used as a stop-out, as in the case of a soldered piece.

We are now ready to proceed with waxing up the case. Unlike the casting of inlays, the wax to be used is of little importance except as regards its tenacity in holding the parts together and the facility with which it may be carved. A good, sticky-wax is best to unite the parts so that they may be removed from the mouth or the model. The operation may then be completed with pink baseplate wax, which carves very nicely, or with any of the casting waxes on the market. Flow on enough wax to give the desired contour and build the incisal edge to a thickness about equal to No. 20-gauge plate. Trim the wax flush with the end of the backing, which, as previously mentioned, must be slightly longer than the tooth. This is with the object of protecting the porcelain when the piece has been finished and finally mounted, which object may be still farther advanced by grinding the porcelain very thin, thus precluding the possibility of contact with the occluding tooth. After grinding, the porcelain may be repolished with gloss sticks or other polishing material.

Of course, the entire Richmond or bridge dummy, including the backing and post, may be cast in one piece if desired, in which case the method of procedure would be first to grind the tooth into place, either in the mouth or on the model, and then remove and either thoroughly wet or oil the slot and back of the tooth. Then flow on, to the proper thickness, some good casting wax, being sure to have the slot well filled. After chilling it may be waxed to place, carved as desired, the tooth removed and the case proceeded with as hereafter described. There are some serious objections to this method, however, the chief of which are, first, the difficulty of removing and replacing the tooth without distorting the post or backing, and the fact that after casting, the post will fit the slot so closely as to preclude proper cementation when the case is completed. Furthermore, no matter how carefully the piece may be invested, there is almost certain to be some minute globules of gold cast along the post or upon the ridge-lap or backing, which would cause considerable trouble in removing.

Some of these objections may be removed by using the posts for casting which are supplied by the manufacturers, but the danger still remains that the post may be gotten out of alignment or otherwise displaced or the backing distorted. In view of these considerations, I strongly recommend the use of the backings, as supplied by the makers, in the manner already described.

The investment of the piece is next in order, and the *investment material*, next to the *flux*, is of the utmost importance. I shall not enter upon a discussion of the qualities necessary to a good investment, but will give you the formula for, and the method of preparing, that which I have selected as the best, after several years' trial of most of those now offered by the dealers. It is composed of four parts by weight of finely powdered silex and one part of French *impression* plaster. These ingredients must be thoroughly mixed by repeated siftings. I sift them twenty to thirty times through a fine sieve and make up enough at one time to last several months, as the longer the mixture is kept the better it is, provided it is stored in a dry, warm place in *wooden boxes*, the wood tending to absorb any slight moisture it may contain. Too much importance cannot be attached to the mixing and curing of this investment material.

The operation of investing the piece is practically the same as that of investing an inlay. Place the sprue wire so that it points directly into the V-shaped space between the ridge-lap apron and the coping, and mount the piece on the crucible-former. Mix a tolerably thick batter of investment and paint it onto the piece with a very small stiff brush, working it well under the backing post and very carefully excluding even the minutest air bubbles. After the piece is well covered, place the casting ring on the base and proceed to pour the balance of the mix, being careful to add but little at a time, and working it down around the sides of the flask with a small cement spatula, and by holding the flask firmly down and tapping the sides with the spatula handle.

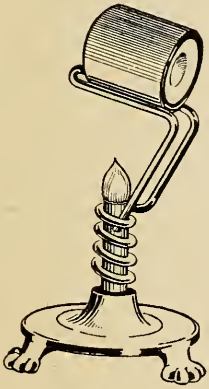
Fig. 4

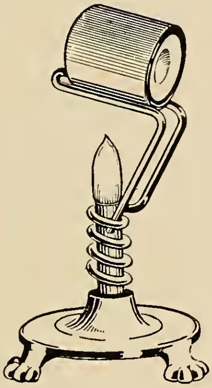
Fig. 5

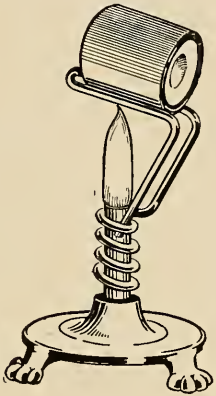
Fig. 6

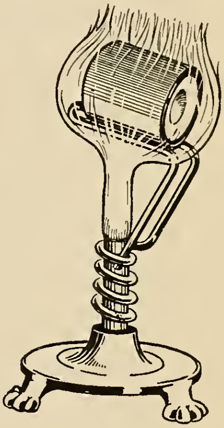
Fig. 7

The correct proportions of investment material and water for a proper mix, as well as sufficient amount to fill the ordinary inlay flask, are 12 dwts. of investment and two teaspoonfuls of water. You double this quantity for a larger flask. Procure a small tin ointment box, and after weighing this amount shake it well down level and trim the box to the level of the material; you will then have a correct measure for all subsequent mixes.

When the investment is set, which will be in about eight minutes, warm and remove the crucible-former. Grasp the sprue wire with a pair of hot pliers, holding it so for a few minutes that the heat may be transmitted to the wire, when it may be easily withdrawn. Place the flask on its side on an inclined rack, about two inches above the opening of a Bunsen burner, with the sprue opening at the lowest point—that the melting wax may to a certain extent drain out. Have the flame turned as low as possible. It should not be more than half an inch high, as shown in *Fig. 4*. Keep at this point for twenty-five minutes, at the end of which time turn it up to about an inch (*Fig. 5*). At the end of five minutes more turn up until the flame barely touches the flask (*Fig. 6*), and after another five minutes turn on the full flame (*Fig. 7*). After five minutes more it is ready for the cast. To summarize: Twenty-five minutes for the first heat, five minutes for the second, five minutes for the third, and five minutes for the fourth—forty minutes all told. Have the air and gas so regulated in the burner that it will burn with a slightly yellow flame rather than a noisy blue one. The flame during the last heat will then lap entirely around the flask instead of splitting off at the sides. At the end of the time allotted for the heating the flask should show slightly red, but the investment not at all, and it must be removed from the fire and the cast made without allowing it to cool longer than is necessary while preparing to melt the gold.

The gold to be used in casting must necessarily be of considerable lower karat than that which it is to be cast upon. It has generally been conceded that the solder sold for use with 20k. plate is good enough for a soldered bridge. At any rate, it is the highest karat that can be safely used in casting upon 20k. gold or platinized gold backings. If you wish to use a finer gold you must have pure gold or pure platinum backings. Before fusing the solder for making the cast it must first be melted into a nugget upon a charcoal block, using plenty of borax and applying only just sufficient heat to accomplish the purpose. Do not attempt to use less than four dwts. of solder for casting a Richmond, and more in the same proportion for a bridge, as it is important to have plenty of excess. Note carefully the sluggish action of the solder under the blow-pipe so that you may be able to judge when fusing for the cast just when the fusion is complete, as it will not dance and boil as a higher grade of gold usually does. Also after casting, the pressure must be sustained a little longer than is necessary when using a higher grade of gold.

The technic of casting a bridge does not differ materially from that of a crown, except that provision must be made for easily removing it from the model and a greater number of feeders supplied.

Before pouring the impression any shell crown must be partly filled with wax and the posts of Richmond crowns partly covered so that by slightly warming they may be readily removed and replaced after cleaning. The model must then be slightly oiled between the abutments with liquid vaseline or other oil, and the case proceeded with as in case of a soldered bridge. This, however, is one of the methods often used in soldered work.

After the case is waxed and carved as it is desired to have it reproduced, there is nothing more to do but to fix the sprues and proceed to invest and cast.

The feeders must be at least three in number—one wire placed about the center and two feeders formed by little rolls of wax, one at either end of the bridge converging to the free end of the wire and waxed to it with a hot spatula. It may now be mounted upon the base or crucible-former and proceeded with as previously described.

In conclusion, I will recapitulate the more important considerations:

First: The method of fluxing, which has not to my knowledge been published before, is *absolutely essential* to a perfect union between the metal cast and the metal cast upon and will invariably produce that result.

Second: The investment must be one that will not shrink or check and one that will spread with a brush like paint and fill in smoothly without bubbles.

Third: The case must not be overheated—the merest approach to redness of the flask is permissible, but the gold within must *not* reach the red heat. This result will be closely approximtaed by following the formula for heating as given, but by experiment may be changed to suit any slight difference in the burner used.

Fourth: If solder is used in casting much caution must be used not to overheat in fusing, but be sure it *is* fused and cast as soon as you are certain that it is.

If these four essentials are carefully observed there will be few, if any, failures.

ANCIENT ORIGIN OF DENTAL CASTING

BY L. W. STRYCKER, NEW YORK

The object in preparing this article is not to change public opinion nor to bring discredit upon anyone. Rather is it to enlighten the dental public upon a subject concerning which much erroneous information is extant, in the hope that others may take up the subject and work it out for the benefit of all, as did the Old Masters in an age when time was nothing and art everything.

The facts herein laid before the public may have been gained by the study of old text-books as well as from the references to current authorities that are given. Being in possession of this knowledge, the writer looks upon it as his duty to give it out. By withholding it, he would lay himself open to the charge of secretiveness, and bring dishonor upon himself in later years.

Of course, only the most brief outline can be given in such an article. Any attempt to print all of the valuable information that has been gained by this investigation would be entirely out of the question, as volumes would be required to reproduce it. The books themselves should be read by every man who is interested in the subject sufficiently to take the time necessary. For those who have not the time at their disposal, this brief resume has been prepared, and is here offered for what it may be worth to the profession.

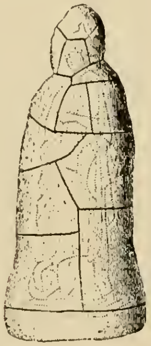

Fig. 1—"Malaga a la Francaise," or piece casting. The model completed.

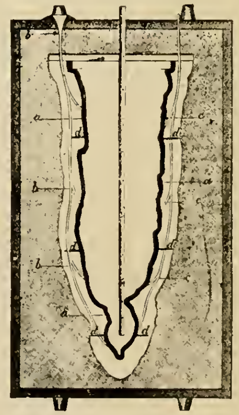

Fig. 2—Piece casting; the model "invested."

The most cursory investigation of the authorities given will convince any man that casting by the so-called "modern" processes is by no means new; that it is simply a neglected and almost forgotten art. In taking up the subject we must go back to the most ancient text-books and records, the older the better. The methods that we are now so eager to learn are handled by the Old Masters in the founding art with most satisfactory clearness and particularity of detail. Especially is this true of the "Cire Perdue" or disappearing model or "wasting wax" process, which was known and in common use almost countless ages ago.

This also is true of two of the methods for forcing the metal into the mold in common use today—centrifugal force and pressure. The centrifugal method is first mentioned in the old books, and we reproduce an illustration of one of these ancient centrifugal casting machines. (Fig. 4.) This was used for casting bronze busts and other objects of art.

Later the mechanical pressure and air-pressure machines were invented and became well known. Illustrations are given of these ancient devices. (*Figs.* 5 *and* 7.)

The earliest account of the casting of bronze by the cire perdue or disappearing wax model process is given in *Knight's American Mechanical Dictionary* as 2230 B. C., and has to do with a reference by Herodotus and Diodorus to massive bronze statues that were set up in the Temple of Belus, in Babylon.

In Isaiah, xliv, 12, written about 712 B. C., is an account of the making of the golden calf by Aaron, supposed to be several centuries earlier, or about 1491 B. C. "He," Aaron, "received then the golden earrings of the people at their hands, and fashioned it with a graving tool, after he had made of it a moulten calf."

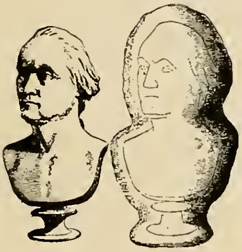

Fig. 3—"Cire Perdue," or Waste-Wax Method. Identical with Modern Disappearing Model Methods.

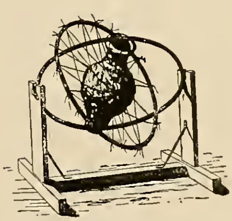

Fig. 4—Ancient Centrifugal Casting Machine. Date unknown.

The Colossus set up by Nero the Roman emperor, before his golden house, near the site of the Temple of Venus at Rome, was a bronze figure of himself, the work of Zenodorus. This also was cast by the cire perdue, or diappearing wax model process.—*Knight's American Mechanical Dictionary.*

Myer's Ancient History tells us that bronze was cast by the Greeks about the eighth century B. C., which also speaks of Lycippus as being renowned for his works in bronze.

This knowledge, that the ancients were in possession of the greatest skill in the art of casting metals, lets a flood of light in upon some of their most famous productions now preserved in museums. Until this was learned concerning them, the wonder was how such marvelous reproductions could have been made with the crude methods supposed to be at their command. The use of the disappearing wax model, invested and cast upon a large scale, it is true, but in precisely the same manner as that now employed in dentistry, makes all that clear.

"The great bronze lions of the Nelson Monument in London are a sad example of the present low state of the founder's art. Coarse sand casting in England now takes the place of the delicate cire perdue process."—*Encyclopedia Britannica,* Vol. 14, page 79.

The full-length recumbent effigies of Henry III and Queen Eleanor at Westminster, cast in bronze by this process (disappearing wax model method) are equal, if not superior, in artistic beauty to any sculptor's work of the same period." (End of the thirteenth century.) —*Encyclopedia Britannica,* Vol. 14, page 77.

"The great candelabrum in Seville cathedral is the finest specimen of the sixteenth century metal work in Spain. It is mainly the work of Bart Morel, in 1562. It is cast in bronze, enriched with delicate scroll-work, foliage and numbers of well-modeled statuettes, cast by the disappearing wax model method."—*Encyclopedia Britannica,* Vol. 14, page 76

"In Work-Shop Receipts," published by E. Spohn, London, page 221, is described the two methods of wasted-wax castings: 'Malaga a la Francaise,' or piece casting. (*See Figs.* 1 *and* 2). The other process is that known as cire-perdue, or waste-wax pattern. It is the more ancient of the two and has been practiced from time immemorial by the artists and artisans of Italy." (*See Fig.* 3.)

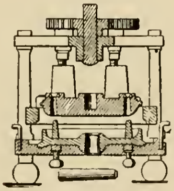

Fig. 5—Pressure Casting Machine, about 1819.

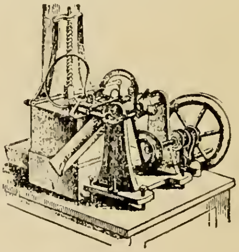

Fig. 6—Type Casting Machine. Casts by pressure.

"The mention of molds for the casting of wax figures is ascribed to Lysistratus, about 328, B. C."—*Knight's American Mechanical Dictionary,* Vol. 2, p. 1459.

"Suppose a small ornamented vase were to surmount the pillar; the founder would prepare the pattern for this in a more elaborate manner. He would first mold it in *wax.*"—*Chamber's Encyclopedia,* Vol. 4, p. 454. Published 1870.

"An old method which still is employed in Italy is to make a core composed of potter's clay, brick dust, cow's hair or some other composition, and over this to model the figure in *wax*. then the other mold is formed on this of some composition of which loam is the principal part. The whole is then dried, and baked, in an oven, *until the wax is melted and cleaned, and the mold is rendered sufficiently porous.*"—*Amn. Cyclopedia,* Vol. 4, p. 85. Published 1875. (The italics are mine.)

"Castings of *great delicacy* are produced by using models of *wax*. These are embedded in molds of finely-ground earth, which are then heated *red hot*. The mold is baked and *the wax disappears* and the metal, when poured, exactly takes its place."—*Knight's Amn. Mech., Dict.*, Vol. 1. Published 1880.

The most clearly written directions for using the disappering wax model method are given on page 72, vol. 14, *Enc. Brit.,* published in 1891, by R. S. Peale Co., Chicago. These directions were reproduced almost word for word, sufficiently so to warrant the assertion that they are identical, in the first directions given to us for the casting of inlays and the like; particularly where we are told to "use an investment mixed with water to the consistency of cream, and apply with a brush, until a coating is formed over the wax,"etc. Here is the quotation:

"METHODS OF MANIPULATION IN METAL WORK."

"Gold, silver and bronze may be treated in various ways the chief of which are (1) casting in a mold, (2) treatment by hammering and punching (swaging; French repoussee.) The first of these, casting, is chiefly adapted for bronze, or in the case of more precious metals only if they are used on a very small scale. The reason for this is that a repoussee relief is of much thinner substance than if the same design were cast, even by the most skillful metal worker, and so a large surface may be produced with a very small expenditure of valuable metal.

"Casting is probably the most primitive method of metal work. This method has passed through three stages, the first being represented by solid castings, such as are most celts and other implements of prehistoric times, the mold was formed in clay or stone, and the fluid metal was poured in until the hollow was full. The next stage was, in the case of bronze, to introduce an iron core, probably to save needless expenditure of the more valuable metal. The British Museum possesses an interesting Etruscan or archaic Italian example of this primitive device. It is a bronze statuette from Sessa, on the Volturus river, about two feet high, of a female, standing, robed in a close-fitting chiton. The presence of the iron core has been made visible by the splitting of the figure, owing to the unequal contraction of the two metals.

"The third or last stage in the progress of the art of casting was the employment of a core, generally of clay, around which the metal was cast in a mere skin, only thick enough for strength, without waste of metal.

"The Greeks and Romans attained to the greatest possible skill in this process. Their exact method is not certainly known, but it appears probable that they were acquainted with the process now called cire perdue (wasting wax method), the same as that employed by the great Italian artists in bronze, and *still unimproved upon, even at the present day.* Cellina, the great Florentine artist of the sixteenth century, has described it fully in his *Trattato della Scultura.* If a statue were to be cast, the figure was first roughly modeled in clay, only rather smaller in dimensions than the future bronze; all over this a skin of wax was laid and worked by the sculptor's modeling tools to the required form and finish. A mixture of pounded brick, clay and ashes was then ground finely in water, *to the consistency of cream*; and successive coats of this mixture were then applied *with a brush,* until a second skin was formed all over the wax, fitting closely into every line and depression of the modeling. Soft clay was then carefully laid on to strengthen the mold, in considerable thickness, till the whole statue appeared like a shapeless mass of clay around which *iron hoops or rings* were bound to hold it all together.

"The whole was then thoroughly dried and placed in a hot oven, which baked the clay, both of the core and the outside mold, *and melted the wax,* which was allowed to run out through small holes made for the purpose. The mold was now ready for casting," etc.

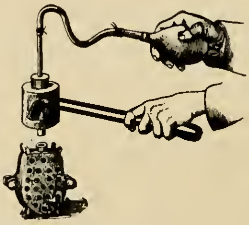

Fig. 7—Dr. Carroll's Air Pressure Casting Machine, 1885-6.

So here we have a fairly accurate and connected history of the *disappearing model process,* and will next take up casting machines in the use of which pressure was employed.

Our cut, *Fig. 4,* shows a primitive centrifugal machine, used for casting a bust.

Knight's Amn. Mech. Dict., Vol. 1, published 1880 says: "In the English patent, No. 3197, January 28, 1809, the molds for casting are upright and are made to revolve on pivots or spindles. The centrifugal force causes the metal to fill up all parts of the mold." It also says: "In an American patent of 1857 the car wheels are revolved (while being cast) so that the first metal poured is made to form the tread of the wheel, and the second portion to form the body of the wheel," and further: "In Bessemer's patent the metal is poured into fast-revolving cylinders, the rapid rotation of which causes the metal to collect on the inside of same, when it is allowed to cool. It is then split open and rolled."

The same volume then speaks of pressure casting machines. "To obtain the best results in compact metal castings, destitute of porosity, and with sharp definition on the angles and ornaments, casting under pressure has been devised. See Hollingrake's English patent, 1819."

Following this it gives a drawing of the machine, which we have reproduced as *Fig.* 5. Going farther, it says:

"In one case the molds are so arranged that the top part serves as the followers of a press, and is operated on by screws. The top part fits closely into the matrix and is provided with ingates for the metal, which are closed by slides when the mold is full. The *pressure* is applied to the metal while in a melted state, with *sufficient force to expel the air* and *gas from and solidify the metal.*"

Then it speaks of Smith's process of compression casting. The face of the article is covered with a preparation of potter's clay, the model is withdrawn by a little India-rubber suction apparatus, "and we have an exact fac-simile, ready, when dried, to be cast from. Nothing can exceed the beauty of the result by casting the metal under pressure in the mold. Thus prepared, screws and nuts which never had a tool put on them, leave nothing to be desired in the way of accuracy and completeness."

On page 604, describing the term "compression-casting," we find this: "A mode of casting bronzes, etc., in molds of potter's clay, under a pressure which causes the metal to flow into the delicate tracery left by the pattern. This work nearly approaches the work of the graver and chisel. It is especially used in casting house-builders' hardware, letters, numbers for houses, etc."

In Vol. 2, page 1462, is the following: "Soft and perishable objects may be so molded as to produce a single casting by one of the several following methods which are adapted to the procuring of castings of small animals, insects, flowers, feathers, ferns, sea-weed, wax models, etc.:

1. Support the object in the center of a small box, by needles; one or two should be sufficiently large to form ingates. Fine river mud is dropped into the box and shaken around so as to adhere to the object. When partially dry, a coarser grade of silt is thrown in until the box is filled. The needles and ingate wires are withdrawn, the mold burned to reduce the object to ashes which are shaken or blown out, when the mold is ready for casting.

2. Another method is to take the object itself or a *wax model,* such as that of a flower, and suspend it in a box while plaster of Paris is carefully poured around it. The application of heat causes the object to burn *or the plaster to absorb the wax*; or, if the latter be in excess, it may be poured out. The strings by which the object was suspended are withdrawn and the mold is ready for casting. This plan was adopted in casting the feather of the equestrian statue of George III, at Pall Mall, London; and specimens of ears of

wheat, flashy flowers, such as coxcomb, and other beautiful objects."

We are indebted to the Italians and French of the fifteenth, sixteenth and seventeenth centuries for *safe* molds; the ones mentioned above are termed waste molds.

On page *2312*, Vol. *3*, this work describes the casting of busts and statuary. The print is very fine and the article would fill a single issue of any of our dental journals. The article was written in 1844. The description in part follows:

"The present system of statuary casting is as follows:

1. Take a cast in plaster sections, which together form a matrix.
2. Cover the inside of these sections with a *shell of wax*.
3. Place the sections together so as to form a mold.
4. Fill the inside with clay or slush, so as to form a core with supports to sustain it independently of the mantle.
5. Remove the plaster sections, *the wax adhering to the clay.*
6. Work up the wax surface into complete form by hand.
7. Coat with porous clay composition to form mantle.
8. *Bake in a furnace, melting or burning out the wax.*
9. Run the metal into the baked clay mold.

The church of St. Isaac at St. Petersburg is decorated with a large number of statues and figures in relief obtained by this process."

On pages 2674-2675, Vol. 3, the type-casting machine is described, showing the Bruce machine, and says that in 1850 a French invention by M. Didot was designed to cast about 200 types at once, requiring about twenty seconds. Pressure brought to bear upon the molten metal forced it into all the recesses of the molds.

Wescott's machine, U. S. patents 115796, June 6, 1871; 169215 and 169216, October 25, 1875, casts and sets the type by pressure on the molten metal.

In the *American Cyclopedia*, Vol. 13, p. 791, published 1875, we find the following: "There are difficulties in making large, thin vases, which have been overcome at Sevres by the employment of atmospheric pressure and exhaustion. A plaster mold is used, and the cast is made either by covering the mouth of the mold and forcing air into the interior, or by exhausting the air through the porous plaster by means of an exterior air-tight case."

The Century Dictionary and Cyclopedia, Vol 1, p. 849, published 1889, in describing the meaning of the words "Compression Casting," uses these words: "A method of casting in molds of potter's clay, with sufficient pressure to force the metal into the most delicate tracery left by the pattern. It is used in casting letters, stamps, house numbers, house builders' hardware, etc." Further on it defines the meaning of the words "Casting Press" as "a press in which metal is cast under pressure."

Chambers' Encyclopedia, Vol 9, p. 606, published 1870, says that various attempts were made during the early part of the century to cast type by machinery, but that the first successful type-casting machine was invented by David Bruce, Jr., of New York, and patented March 17, 1838.

The first type-casting machine was patented in the United States in 1828 by William M. Johnson, but it did not produce good types. The patent was sold to George Bruce, and the machine was used by him until 1845. David Bruce meanwhile patented another machine, 1843, with improvements two years later, which gave entire satisfaction and is now in general use in American type foundries.

This same volume gives an illustration of a type-casting machine and describes it as follows:

"A type-casting machine consists first of a small melting-pot, which contains the molten metal. In the interior of the pot is arranged a *forcing pump* and a valve for admitting the metal under the piston, *and* also for preventing the return of the metal into the mass in the pot when the piston is depressed, and thus securing the full force exerted upon the piston being transmitted by the piston to the molten metal uner it, and *forcing it through a narrow channel to the mold,"* etc.

The Century Dictionary, Vol. 3, p. 2531, in describing pressed glass says: "Glass while in a molten state, is brought to shape in a mold by a plunger."

The Encyclopedia Britannica, 9th edition, Vol. 18, p. 481, describes a method of casting steel ingots employed by Sir Joseph Whitworth, by applying hydraulic pressure to the metal in the mold until it solidifies, which "has been adopted by the inventor with great success in the prevention of blow-holes and similar imperfections."

Now, let us see what all this has to do with dentistry. (*Fig. 7.*) This illustration shows a machine devised by Dr. C. C. Carroll, of Meadville, Pa., in 1885 or '86, for casting plates by the pressure process. Dr. Carroll turned over his invention unreservedly to the profession, the following paragraph appearing in the copy of Directions given with the machine:

"These goods are placed before the profession on their merits, upon the most liberal terms, without any charge of license or royalty upon the patents by which they are covered, and by the use of which all other patents for crowns, bridges, etc., are evaded."

He also gives full directions for casting, and says: "Maintain the pressure about five seconds to give the molecules of metal time to arrange themselves *under pressure.* Otherwise there may be small pits over the surface of the denture."

He further says: "Mold upon the teeth in thin paraffin wax the crown or bridge that is intended to be worn," etc. It seems fair to assume that he made his abutments and no doubt his inlays in the same manner.

Now, let us turn to periodical literature on the subject:

In the account of the meeting of the First District Dental Society, State of New York, Tuesday evening, March 13th, 1894, at the New York Academy of Medicine, published in the *Dental Cosmos,* Vol. 36, No. 5, May, 1894, appears the following:

"Dr. George F. Reese, of Brooklyn, N. Y., demonstrated the method of adjusting his gold alloy cast crown:

"A right superior lateral roof was selected in a lady patient. He had the root already prepared; then the artificial crown, which was a plain rubber tooth, was ground to fit to the root and gum; next a piece of platinum wire, coated with gold the length of the root, was hammered flat at the exposed end and bent into a foot shape. It was then fastened by wax to the artificial crown and an impression of the root was taken. This was put in and removed a number of times, the surplus taken off with a heated spatula until adaptation and contour were correctly obtained, down to the finest detail. It was then placed in cold water to harden the wax and tried in again. Everything being found satisfactory, two points of wax were put on the back of the crown, which was then invested in plaster of Paris. After hardening, the wax was grooved out, the matrix heated, and the wax melted out by a fine stream of boiling water. Two pockets were then made, one being the pouring, the other the vent gate. This was again invested in plaster, which was now ready after hardening and standing a couple of hours to be put in the drying oven. When dry, which is shown by the mirror test, the gold alloy was melted and heated until it turned a purplish tint, when it was ready to cast.

"The doctor, after finishing, proceeded to insert a duplicate crown. By so doing it was shown that the crown fitted perfectly. He then permanently fastened it by drying out the root and coating the crown root with oxyphosphate cement."

Page 269 of the April, 1889 *Dental Cosmos,* shows us the following: "Dr. Reiss, of Brooklyn, showed a specimen of an improved porcelain crown."

Page 293, same number: "Dr. J. N. Crouse, by permission, called attention to the Dental Protective Association. He said that it was necessary to act at once as they must have money now to carry on the fight against The Tooth Crown Company."

In concluding I wish merely to say that I believe in giving credit where credit is due; and that to me it seems that credit is, in this case, undoubtedly due to the man who devised the crown and bridge that has stood the test of time and promises to stand indefinitely, rather than to one that has done nothing more than to revive an art that has been practiced in all branches of metal work from time immemorial, that probably is as old as man's knowledge of metals, and for which, at this late day, great claims for originality are made.

As to the kind of work that is being done in dentistry along that line, the average result is described by Dr. Rhein, of New York, who, at a recent dental meeting, spoke of the average inlay as "A floating island of gold in a sea of cement."

Unless the average practitioner shall learn speedily to cast better inlays and insert them with greater skill, there most certainly is grave danger that the inlay method will bring discredit upon the entire profession.

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